

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(Tabular dollars in thousands, Narrative in whole dollars)

INDUSTRY SECTOR

PROGRAM MISSION

Industry's efficient use of energy is critical to the U.S. energy economy. Industry consumed almost 31 quads of primary energy in 1994--about 38% of all energy used in the U.S. Of this amount, about 25 quads were used in manufacturing. Within manufacturing, energy use is concentrated in a relatively small number of industries. Based on the 1994 Manufacturing Energy Consumption Survey (MECS), pulp and paper, primary metals, chemicals, petroleum refining, and stone, clay and glass accounted for 82% of all energy used in manufacturing in 1994.

Efficient energy use and waste disposal are important to industry. Industry spent about \$104 billion on energy in 1993 and about \$29 billion for pollution abatement and control. While for all industry this represents less than 5% of total costs of operation, for material and process industries, the percentage of costs attributable to energy and waste ranges from about 7% to over 30%. In the last ten years, energy has become less important as a driver of U.S. industry investment decisions because natural gas, electricity, and imported oil have been readily available at attractive prices, and energy costs have been declining as a percent of product selling price. However, because of their intensive energy use, energy is still an important driver of investment and operating decisions for materials and process industries.

Concerns about generation of pollution and the levels and types of industrial wastes are increasing. Industry generated 14 billion tons of waste in 1994, including over 200 million tons of hazardous and toxic wastes. Manufacturing accounts for about 65% of all industrial wastes, and almost all of the hazardous and toxic wastes. Within manufacturing, materials and process industries account for about 80% of the hazardous and toxic wastes, and about 95% of non-hazardous waste. These wastes often impose expensive clean up and disposal costs, but offer the potential for recovering the "embedded" energy and materials value.

Manufacturing jobs are important to the economy. About 18 million people are employed in manufacturing. Also, many manufacturing jobs are higher paying, higher skilled jobs compared to many jobs in service industries. Manufacturing jobs are also a strong stimulus to

PROGRAM MISSION - INDUSTRY SECTOR (Cont'd)

the economy with a multiplier of 4 jobs in the economy being created for every manufacturing job created. Manufacturing jobs have declined from 19.6 million jobs in 1974 to 18 million today.

There are substantial opportunities for the Office of Industrial Technologies to help improve the competitive climate for U.S. industry. While many energy and waste intensive industries have been in decline over the last 20 years, new innovations in technology could reverse the decline. Overall, up to \$10 billion per year or more in energy costs could be saved by industry. The Office of Industrial Technologies (OIT) has targeted six industries: steel, aluminum, metal casting, chemicals, forest products, and glass for an Industries of the Future strategy. A seventh industry, petroleum refining, has been dropped because of a lack of perceived need by industry for DOE assistance. Research is accomplished primarily through competitive solicitations, including in FY 1999 a broad industry solicitation, guided by industry-developed technology road maps to ensure focusing on key needs and best performers. This approach matches DOE's economic, environmental, and science and technology goals with the needs and expectations of technology users in the private sector, and targets Federal R&D investments to market requirements. OIT is establishing partnerships with industry and government to develop the advanced manufacturing and process technologies which have the best chance of strengthening U.S. materials and process industries. Many of the individual firms in these industries are small or medium sized and do not have the resources to pursue the often expensive and lengthy research needed to develop advanced technologies. These advanced technological options can preserve existing industry jobs as well as create new jobs, and can result in increased exports. They can also provide strong economic and environmental benefits without the market dislocations which regulatory approaches often embody.

The GOAL of Industry Sector programs is to significantly improve the resource efficiency and competitiveness of energy and waste intensive U.S. industries by rapidly developing and delivering advanced science and technology options which will have the OBJECTIVES of: 1) lowering raw material and depletable energy use per unit output; 2) improving labor and capital productivity; and 3) reducing generation of wastes and pollutants.

Analysis of OIT programs indicate that if OIT technologies are successfully developed it would lead to reductions of 1.5 quads in industrial energy demand by the year 2010 (depending on speed of market penetration of new technologies). This would also result in annual carbon reductions of over 30 million metric tons. The industrial technologies not only improve industrial productivity through reducing energy cost expenditures, but also through other process productivity enhancements and innovative solutions for environmental requirements. The non-energy productivity improvements are expected to lead to even greater savings than the energy cost savings. The OIT programs working with industry are also expected to preserve and increase industrial jobs by helping the international competitiveness of U.S. industry by energy productivity improvements and waste reduction.

PROGRAM MISSION - INDUSTRY SECTOR (Cont'd)

The Office of Industrial Technologies delivers its programs through three mechanisms: Industries of the Future (Specific), Industries of the Future (Crosscutting) and Technology Access. The Industries of the Future (Specific) mechanism cost-shares with industry and other organizations technology development identified in industry-wide developed visions and roadmaps. These technologies are chosen based on their ultimate impact on energy and waste reduction, high priority and high risk to meet roadmap targets, wide-spread industry applicability and precompetitive nature. They are technologies that are specific to an industry's processes. The Industries of the Future (Crosscutting) cost shares with industry and other organizations technology development beneficial to and of high priority for many industries. Power generation equipment, combustion equipment and sensors and controls are pursued. In addition, advanced materials that can address a multitude of wear and corrosion problems are explored. The Technology Access mechanism delivers information and tools to help plant managers make informed decisions on technology choices today that result in energy, waste and dollar savings. In addition, new ideas from inventors are supported and grants for demonstration of near-term viable technologies are funded. These mechanisms provide an integrated set of options responsive to the near, mid and long term goals and objectives of industry. They are also responsive to the National goals of improved energy efficiency, expanded adoption of pollution prevention, increased productivity, and more globally competitive industries.

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(Dollars in thousands)

PROGRAM FUNDING PROFILE

Industry Sector

Activity	FY 1997	FY 1998	FY 1999	FY 1999	Program Change Request vs. Base	
	Enacted	Enacted	Base	Request	Dollar	Percent
Industries of the Future (Specific) Operating Expenses	\$ 45,332	\$ 53,078	\$ 53,078	\$ 76,000	\$ 22,922	43%
Industries of the Future (Crosscutting) Operating Expenses	\$ 38,378	\$ 49,120	\$ 49,120	\$ 49,400	\$ 280	1%
Technology Access Operating Expenses	\$ 24,827	\$ 26,299	\$ 26,299	\$ 32,000	\$ 5,701	22%
Management and Planning Operating Expenses	\$ 6,887 ^{b/}	\$ 7,700	\$ 7,700	\$ 9,159	\$ 1,459	19%
TOTAL	<u>\$ 115,424 ^{a/}</u>	<u>\$ 136,197</u>	<u>\$ 136,197</u>	<u>\$ 166,559</u>	<u>\$ 30,362</u>	<u>22%</u>
Summary						
Operating Expenses	<u>\$ 115,424</u>	<u>\$ 136,197</u>	<u>\$ 136,197</u>	<u>\$ 166,559</u>	<u>\$ 30,362</u>	<u>22%</u>
Total Program	<u>\$ 115,424</u>	<u>\$ 136,197</u>	<u>\$ 136,197</u>	<u>\$ 166,559</u>	<u>\$ 30,362</u>	<u>22%</u>
Staffing (FTE's)						
HQ FTEs	59	61	61	61		
Field FTEs	<u>11</u>	<u>11</u>	<u>11</u>	<u>11</u>		
Total FTEs	<u>70</u>	<u>72</u>	<u>72</u>	<u>72</u>		

a/ Reflects adjustment for approved reprogrammings 97-R-12 of \$-1,883.2 thousand for the Small Business Innovative Research (SBIR) program and \$-148.7 thousand for the Small Business Technology Transfer Pilot Program (STTR) activities.

PROGRAM FUNDING PROFILE: Industry Sector (Cont'd)

- b/ Reflects adjustment of -\$113.0 thousand for approved reprogramming 97-R-15b totaling \$337.0 thousand to support Transportation Sector Program Direction activities.

Authorizations:

P.L. 102-486, "Energy Policy Act of 1992"

P.L. 94-163, "Energy Policy and Conservation Act" (EPCA) (1975)

P.L. 94-385, "Energy Conservation and Production Act" (ECPA) (1976)

P.L. 95-91, "Department of Energy Organization Act" (1977)

P.L. 95-618, "Energy Tax Act of 1978"

P.L. 95-619, "National Energy Conservation Policy Act" (NECPA) (1978)

P.L. 95-620, "Powerplant and Industrial Fuel Use Act of 1978"

P.L. 96-294, "Energy Security Act" (1980)

P.L. 100-12, "National Appliance Energy Conservation Act of 1987"

P.L. 100-615, "Federal Energy Management Improvement Act of 1988"

P.L. 101-218, "Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989"

P.L. 101-549, "Clean Air Act Amendments of 1990"

P.L. 101-575, "Solar, Wind, Waste, and Geothermal Power Production Incentives Act of 1990"

P.L. 93-577, "Federal Nonnuclear Energy Research and Development Act of 1974"

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
ENERGY CONSERVATION
(dollars in thousands)

SUMMARY OF CHANGES

Industry Sector

FY 1998 Enacted	\$ 136,197
FY 1999 Base	0
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	\$ 136,197

Industries of the Future (Specific)

- Forest and Paper Products Vision - The increase essentially maintains the FY 1998 level of effort and supports the implementation of Agenda 2020 to further the national goals of reduced energy consumption, environmental compatibility and resource efficiency in the Forest and Paper Industry.	36
- Steel Vision - The increase will fund new R&D responsive to industry-identified and prioritized needs related to material recycling and environmental improvements gained through efficiency and productivity increases.	901
- Aluminum Vision - The increase will be used to support the energy-efficiency R&D needs of the industry, as identified in the Aluminum Industry technology roadmap and the Mining Industry technology roadmap.	1,843
- Metal Casting Vision - The increase will support activities identified in the Metal Casting Vision and roadmap.	317
- Glass Vision - The increase will be used to fund a competitive solicitation in support of the glass industry technology roadmap to conduct R&D in the following areas: production efficiency, energy efficiency, environmental protection/recycling, and innovative uses of glass.	947
- Chemicals Vision - The increase will fund projects in support of biobased renewable feedstocks and additional projects in support of the chemical industry Vision 2020 solicitation.	2,878
- Petroleum Refining Vision - The decrease reflects the closeout of the Petroleum Refinery Vision activities.	-3,000

SUMMARY OF CHANGES: Industry Sector (Cont'd)

- Industry-Wide Solicitation - The increase will fund a competitive solicitation which will focus on reducing climate change gases, and increasing efficiency in the industrial sector. This will result in higher productivity at the plant level, increased or sustained jobs, and roughly 40 new technologies developed. 19,000

Industries of the Future (Crosscutting)

- Cogeneration - The decrease will reduce the technology development in the Advanced Turbine Systems Program including advanced materials, such as coatings, ceramics, and alloys. -1,650
- Advanced Materials and CFCCs - The decrease essentially maintains activities at the FY 1998 level of effort. -70
- Combustion Technologies - The increase will initiate a cross-cutting program in combustion and sensor R&D in direct support of the vision industries. 2,000

Technology Access

- IACs/Technology Transfer - The decrease will impact technology transfer and communications activities. -409
- Motor Challenge - The increase will support expanded Motor Challenge activities, and the development of new partnerships that assist in the deployment of energy efficient compressed air system and steam system technologies within manufacturing plants. 4,770
- NICE-3 - The increase will fund additional worthy projects. 1,500
- Climate Wise - The net change of \$0 reflects the phase out of the program. 0
- Inventions & Innovation - The decrease will slightly reduce the delivery of support to inventors. -160

Management and Planning

- Evaluation and Planning - The increase will support the development of quality metrics for the vision industries. 200
- Program Direction - The increase will support on-board FTEs and new activities with the Environmental Protection Agency. 1,259

FY 1999 Congressional Budget Request	\$ 166,559
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INDUSTRIAL TECHNOLOGIES
INDUSTRY SECTOR
(dollars in thousands)

INDUSTRIES OF THE FUTURE (SPECIFIC)

I. Mission Supporting Goals and Objectives:

A. Statement of Mission: OIT's Industry Vision strategy aligns its resources with our principal customers--the energy-intensive material and process industries. These industries: steel, aluminum, glass, metalcasting, forest products, and chemicals account for over half of all manufacturing energy use and account for 75 to 90% of most manufacturing wastes for the various waste streams. This energy usage represents over 12 quadrillion Btu (quads) each year at a cost of about \$50 billion. The vision strategy is based on the facilitation of industry developing their vision and the alignment of OIT resources to that vision. The Industries of the Future (IOF) strategy provides the catalyst for tapping into America's vast capabilities in R&D for the development and deployment of advanced energy and material efficient technologies, fosters synergism among different organizations in DOE and other government agencies, and focuses R&D on technologies that are responsive to the needs of each industry and provide benefits at a national level. Benefits in energy savings, improved productivity, use of renewable energy sources, and pollution prevention fulfill both the mission of OIT and industries' technological needs.

Each key activity directly relates to the strategic goals set in the IOF strategy. After the completion of the vision documents, a roadmapping process provides a list of critical prioritized research needs for each of the six industries. The roadmapping process allows the establishment of research teams to address each industry and each vision identified needs. The program areas addressed in the key activities identify opportunities to invest in research partnerships with industry that meet industry's needs and our mission.

B. Program Benefits: Aluminum, Chemicals, Forest Products, Glass, Metalcasting, and Steel Visions

The industries which are the target of the vision of the future strategy in OIT account for a value in shipments of three-quarters of a trillion dollars, total direct employment of 2.6 million, and expend over \$30 billion in capital per year. The estimated benefits by year 2010 from the FY 1999 project portfolio, including those realized directly by the process industries and those from the commercialization of the developed technologies and products used in the end use sector, include:

	2000	2010	2020
Total Primary Energy Displaced (quads)	.02	.70	1.16
Energy Cost Savings (\$ billions)	.06	1.90	3.31
Carbon Reductions (million metric tons)	.37	16.63	28.15

I. **Mission Supporting Goals and Objectives:** INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Many promising fundamental improvements in these energy, waste, and capital-intensive industries that are OIT's principal customers are simply too expensive and too risky for individual private firms to pursue by themselves. OIT acts as a catalyst in drawing together many firms with national laboratories and other interested parties to pool risk, investment, and know-how in promising technologies that are too costly and high-risk for individual firms to develop on their own. The Industries of the Future strategy makes government more responsive and effective. The strategy facilitates integrated planning and implementation by all participants, fosters cooperative planning among different organizations in DOE and other government agencies, and results in R&D focused on technologies that are responsive to the unique challenges each industry faces. In addition, industry partners have emphasized that the Federal participation has acted as a catalyst in the process especially by lending an objective influence, adding credibility, and fostering cooperation between normally competing firms.

C. Performance Goals: Aluminum, Chemicals, Forest Products, Glass, Metalcasting, and Steel Visions.

Strategy/Goal for 2000

The Industries of the Future strategy has provided the framework for industry to complete strategic long range planning and coordination. The goals of this strategy for the year 2000 include:

- All of the industry vision documents have been completed identifying the characteristics of the industry needed in the future to maintain global competitiveness with target values to be achieved in key areas.
- The technology roadmaps for the industries are complete and identify the research priorities needed to achieve the vision targets. Suppliers, end use industries, and research providers have participated in the roadmapping process.
- Implementation plans are being executed to focus available research funding with the roadmapping opportunities.

D. Management and Partnering Accomplishments:

FY 1995

Visions of the Future strategies were completed with the Forest Products Industry and Steel Industries. These partnerships between government and industry were signed by the Secretary of Energy and representatives of the industries.

I. **Mission Supporting Goals and Objectives:** INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

FY 1996

The Metalcasting, Glass, and Aluminum Industries completed their vision strategies. Partnership compacts were signed between the Secretary of Energy and the Metalcasting and Glass industries. The compact signing for the Aluminum Industry was October 9, 1996. The development of technology roadmaps are being developed for each of the industries that have completed their vision strategy.

FY 1997

The Chemical Industry completed its vision and began work on several roadmaps. Funding of research that address needs in each of the vision industries and fulfills the mission of the OIT will continue. Significant redirection of research programs was initiated to focus resources on industry roadmaps as they developed. The outreach to other Federal, state, and regional agencies is a key driver for the success of the industries of the future strategy and where the OIT provides great value added to our industry partners. Efforts in communicating the needs and opportunities developed by industry in their visions as well as coordination of Federal funding for research with these industries is a major thrust of the IOF vision teams.

FY 1998

Initiate work on facilitating visions for the Mining and Agriculture Industries, and facilitating selected State-wide Industry of the Future strategies. Roadmaps will be completed for all six participating industries.

FY 1999

The IOF strategy will continue through the out years. As the market, government regulations, and technology advances drive the industry to reassess their position in the global economy and how their industry must change to be competitive in the future, the IOF strategy will continue to evolve. The Industry of the Future strategy is an ongoing effort which will be revisited in total or by the phases that industry feels need augmentation. The roadmaps phase of the IOF strategy will be updated as the implementation plan identifies new paths for fulfillment of an identified need or new opportunities that must be added to the vision. The vision teams will continue their role as facilitators of the processes, central contacts for industry on federal opportunities for partnering, and partners for the needed research that has the energy, environmental, and economic benefits that fulfill OIT's mission. Research will be conducted based heavily on industry-specific (as well as an industry-wide) competitions and the industry-developed roadmaps.

E. Technical Accomplishments of IOF (Specific) Industries:

Industries of the Future: In response to the Industries of the Future strategy and consistent with the Galvin Commission findings that the national laboratories and facilities must work as a team, a "Memorandum of Cooperation" was signed by DOE national laboratories and facilities. Sixteen national laboratories and facilities have formed a coordinating council to work cooperatively with the IOF

I. **Mission Supporting Goals and Objectives:** INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

industries to determine in what areas the capabilities of the national laboratories and facilities can best be utilized to address the future technology needs of the industry.

Forest Products: The Black Clawson Company commercialized a breakthrough cleaning technology for paper recycling. This new technology enables papermakers to use even lower grades of recycled paper without compromising the quality of the paper produced. This technology will assist the U.S. forest products industry in meeting its 2000 goal of recovering for recycling 50% of all paper used. In addition, this improved cleaning technology achieves greater efficiency while using less energy. These accomplishments were realized with a 45% industrial cost share.

Steel: The first commercial Galvanneal Phase Measurement sensor was installed and is now operating at Stelco Inc. This is the first commercial installation of technology developed under the Advanced Process Control Program. Preliminary result of the sensor's real time output, reporting metal temperature and viscosity, indicate it functions as designed. During the next several months, work will continue on fine tuning and quantifying the benefits of this instrument. Additional commercial installations are anticipated next fiscal year. By the year 2005, the steel industry could save over \$250 million in energy costs from the overall effort due to improved process control.

Aluminum: New technology cathode elements installed in conventional aluminum cells were shown to reduce energy consumption in the production of primary aluminum through a collaborative R&D project between Kaiser and Reynolds Metals Co. Although some of the cathode elements failed during testing in Kaiser full-scale pre-bake cells, test results showed an 8% energy savings compared to a standard cell. Also, there was no loss of aluminum production even with reduced element coverage of the anode due to the material failures. Retrofitting existing alumina reduction cells with wettable cathodes could reduce energy consumption and greenhouse gas emissions in the primary aluminum industry by 10%.

Metalcasting: Through a consortium of OIT, foundries, suppliers, and academia (University of Alabama-Birmingham), a number of significant achievements have been made to improve the lost foam casting process. Development of new coatings has helped to reduce scrap rates in some foundries from 5.5% to 0.25%. A non-destructive evaluation sensor was tested and brought to market, providing a method of dimensional analysis with a precision level of about 0.0005 inches. This significantly improves the ability of founders to increase the dimensional accuracy of castings. Also, a new device, a densitometer, was developed to measure vibration effects on densification around and in patterns during the compaction process. Also developed was a distortion strip to measure distortion amount and when it occurs during compaction. Using the distortion strip in one foundry alone has reduced distortion scrap from 17% to 1%, resulting in a savings of \$60,000/month. The cost sharing percentage is 54%.

Glass: AccuTru International, in cooperation with Corning, Anchor, Owens-Corning, Libbey-Owens-Ford, **Idaho National Laboratory**, Clemson, and several other industrial partners, developed a temperature sensor able to withstand the thermal shock and corrosive atmosphere of molten glass to provide reliable, accurate information over the lifetime of a furnace. Its enhanced abilities will

I. **Mission Supporting Goals and Objectives:** INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

improve the quality of glass products and reduce energy consumption and emissions by optimizing the melting temperatures needed to produce glass. The cost-sharing percentage is 25%.

Chemicals: Pilot plant tests of plastics separation from automobile shredder residue were conducted in partnership with the Vehicle Recycle Coalition and steel, metals, and plastic recycling industries. The technology, developed by **Argonne National Laboratory**, will be tested at a commercial automobile shredder site. Tests will determine commercial feasibility. The cost-sharing percentage is 65%.

II. A. **Funding Table:** INDUSTRIES OF THE FUTURE (SPECIFIC)

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	\$ Change	% Change
Forest and Paper Products Vision	\$ 10,843	\$ 12,040	\$ 12,076	\$ 36	0%
Steel Vision	8,905	9,726	10,627	901	9%
Aluminum Vision	5,503	7,335	9,178	1,843	25%
Metal Casting Vision	3,399	5,480	5,797	317	6%
Glass Vision	2,917	3,883	4,830	947	24%
Chemicals Vision	9,983	11,614	14,492	2,878	25%
Petroleum Refining Vision	3,782	3,000	0	-3,000	-100%
Industry-Wide Solicitations	0	0	19,000	19,000	>999%
Total, Industries of the Future (Specific) . .	<u>\$ 45,332</u>	<u>\$ 53,078</u>	<u>\$ 76,000</u>	<u>\$ 22,922</u>	<u>43%</u>

II. B. Laboratory and Facility Funding Table: INDUSTRIES OF THE FUTURE (SPECIFIC)

	<u>FY 1997 Enacted</u>	<u>FY 1998 Enacted</u>	<u>FY 1999 Request</u>	<u>\$ Change</u>	<u>% Change</u>
Ames	\$ 80	\$ 196	\$ 111	\$ -85	-43%
Argonne National Lab (East)	5,342	4,899	1,318	-3,581	-73%
Brookhaven National Lab	145	148	0	-148	-100%
Idaho National Engineering Lab	612	400	0	-400	-100%
Lawrence Berkeley Lab	787	585	674	89	15%
Los Alamos National Laboratory	600	600	500	-100	-17%
National Renewable Energy Lab	2,644	2,490	252	-2,238	-90%
Oak Ridge National Lab	4,583	2,562	1,509	-1,053	-41%
Pacific Northwest Lab	1,074	1,358	0	-1,358	-100%
Sandia National Laboratories	833	810	800	-10	-1%
All Other	28,632	39,030	70,836	31,806	81%
Total, Industries of the Future (Specific) . .	<u>\$ 45,332</u>	<u>\$ 53,078</u>	<u>\$ 76,000</u>	<u>\$ 22,922</u>	<u>43%</u>

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC)

Activity	FY 1997	FY 1998	FY 1999
Forest and Paper Product Vision	<p>The forest, wood and paper industry produces wood and paper products valued at more than \$230 billion each year. It employs 1.6 million people directly and ranks as one of the top 10 manufacturing industries in 46 states. The pulp and paper industry includes 547 mills in 42 states, and produces 82 million tons of paper and paperboard and 10 million tons of market pulp. With only 17% of the world's pulp and paper mills, the U.S. produces 35% of the world's pulp. Pulp and paperboard are used to publish more than 2 billion books, 350 million magazines and 24 billion newspapers in the U.S. annually.</p> <p>This strategy is a portfolio of near, mid, and long term projects that support Agenda 2020 and further the national goals of reduced energy consumption, environmental compatibility, resource efficiency and strong U.S. manufacturing base. Examples of specific R&D projects and the benefits include: ON-MACHINE ULTRASONIC SENSORS FOR PAPER</p>	<p>This strategy is a portfolio of near, mid, and long term projects that support Agenda 2020 and further the national goals of reduced energy consumption, environmental compatibility, resource efficiency and strong U.S. manufacturing base. Examples of specific R&D projects and the benefits include: COUPLED PHYSICAL/CHEMICAL AND</p>	<p>Benefits of the forest products vision activities to the nation by the year 2010 include increased energy efficiency resulting in energy savings, reduced waste generation, and production cost savings. Over 400 large, medium and small companies, are participating along with other government agencies, national laboratories, universities and states. Jobs saved or created by development of these advanced technologies exceed 12,600 person years in 2010.</p> <p>This strategy is a portfolio of near, mid, and long term projects that support Agenda 2020 and further the national goals of reduced energy consumption, environmental compatibility, resource efficiency and strong U.S. manufacturing base. Examples of specific R&D projects and the benefits include: ENERGY EFFICIENT KRAFT PULPING FOR HIGHLY</p>

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Forest and Paper Product Vision (Cont'd)	<p>STIFFNESS - this technology provides increased data for process control, improved product uniformity; increases energy efficiency, increases use of recycled fibers, and reduces reprocessing; and</p> <p>POLYOXOMETALATE BLEACHING - development of a new bleaching technology that will save energy, allow mills to eliminate water discharge, and eliminate the need for chlorine use in bleaching.</p>	<p>BIOFILTRATION TECHNOLOGIES TO REDUCE AIR EMISSIONS FROM FOREST PRODUCTS INDUSTRIES - development of a cost-effective technology to eliminate air emissions of both VOCs and Hazardous Air Pollutants (HAPs) in the forest products industry; and</p> <p>RECYCLING OF BLEACH PLANT FILTRATES - development of a technology to remove inorganic non-process elements from bleach plant effluent using electrodialysis to enable closure of the pulp mill water stream.</p>	<p>BLEACHABLE, LOW LIGNIN CONTENT PULP - development of advanced control systems specifically targeted at producing low lignin pulps of greatly enhanced bleachability offering a route to integrated pulping and bleaching for an environmentally neutral mill of the future, and</p> <p>DESIGN AND DEMONSTRATION OF MULTIPORT CYLINDER DRYERS - demonstration of a technology to have steam flow through multiport passages that are in close proximity to the cylinder drying surface increasing the drying rate by 100% over conventional drying cylinders.</p>
	<p>R&D Activities:</p> <p>IMPROVED CAPITAL EFFECTIVENESS: Corrosivity Monitoring of Kraft Recovery Boilers; (\$0.5M)</p> <p>ENVIRONMENTAL PERFORMANCE: Sulfur Free Pulping, Paper Mill Sludge Utilization, Polyoxometalate Bleaching, Pulp Bleaching Waste Recycling, CORRIM II Consortium, VOC Control in Kraft Mills, Highly Bleachable</p>	<p>R&D Activities:</p> <p>IMPROVED CAPITAL EFFECTIVENESS: Corrosivity Monitoring of Kraft Recovery Boilers; (\$0.5 M)</p> <p>ENVIRONMENTAL PERFORMANCE: Paper Mill Sludge Utilization, Polyoxometalate Bleaching, Pulp Bleaching Waste Recycling, VOC Control in Kraft Mills, Highly Bleachable Low Lignin Content Pulp, Low-VOC Drying of</p>	<p>R&D Activities:</p> <p>IMPROVED CAPITAL EFFECTIVENESS: (\$0.5M)</p> <p>ENVIRONMENTAL PERFORMANCE: Polyoxometalate Bleaching, Pulp Bleaching Waste Recycling, Volatile Organic Compound (VOC) Control in Kraft Mills, Highly Bleachable Low Lignin Content Pulp, Low-VOC Drying of Lumber and Wood Panel Products, Coupled</p>

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Forest and Paper Product Vision (Cont'd)	Low Lignin Content Pulp, Low Temperature Oxidation of Volatile Organic Compounds, Low-VOC Drying of Lumber and Wood Panel Products, Coupled Physical/Chemical and Biofiltration Technologies to Reduce Air Emissions from Forest Products Industries, Recycling Bleach Plant Filtrates by Using Electrodialysis to Selectively Remove Inorganic Non-Process Elements, Control of the Accumulation of Non-Process Elements and Organic Compounds in Pulp Mills with Bleaching Filtrate Reuse, Photoactivated Ion Exchange Resins, High Efficiency ClO ₂ Delignification, Understanding the Nature and Reactivity of Residual Lignin for Improved Pulping and Bleaching Efficiency (\$3.2M) ENERGY PERFORMANCE: Black Liquor Electrolysis, Black Liquor Properties, High Solids Firing, Electrochemical and Integrated-Process Opportunities for On-Site/On-Demand Generation of ClO ₂ at Reduced Cost (\$2.9M) SENSORS AND CONTROL: Ultrasonic Sensors for Paper	Lumber and Wood Panel Products, Coupled Physical/Chemical and Biofiltration Technologies to Reduce Air Emissions from Forest Products Industries, recycling Bleach Plant Filtrates by Using Electrodialysis to Selectively Remove Inorganic Non-Process Elements, Control of the Accumulation of Non-Process Elements and Organic Compounds in Pulp Mills with Bleaching Filtrate Reuse, (\$4.0M) ENERGY PERFORMANCE: Black Liquor Properties, High Solids Firing, Electrochemical and Integrated-Process Opportunities for On-Site/On-Demand Generation of ClO ₂ at Reduced Cost (\$4.0M) SENSORS AND CONTROL: Ultrasonic Sensors for Paper Stiffness, Automated Sorting of Recycled Raw Materials and On-Line Chip and Web Analysis (\$1.8M) RECYCLING: Stickies Control in Recycle Operations, Infrared Detection of Contaminants (\$0.5M) SUSTAINABLE FOREST MANAGEMENT: High-Yield	Physical/Chemical and Biofiltration Technologies to Reduce Air Emissions from Forest Products Industries, Recycling Bleach Plant Filtrates by Using Electrodialysis to Selectively Remove Inorganic Non-Process Elements, Control of the Accumulation of Non-Process Elements and Organic Compounds in Pulp Mills with Bleaching Filtrate Reuse, Understanding the Nature and Reactivity of Residual Lignin for Improved Pulping and Bleaching Efficiency, Reducing the Emissions of Volatile Organic Compounds, Producing a True Depolymerase for Biobleaching Softwood Kraft Pulp, Electrically Switched Ion Exchange for the Separation of Potassium and Chloride Ions to Enhance Water Recycle, Low Odor, High Yield Kraft Pulping, Reducing VOC Press Emissions from Oriented Strand Board Manufacturing, A New Freeze Concentration Process for Minimum Effluent Processes in Bleached Pulp Mills, Improved Pulping Uniformity by measurement of Single Fiber KAPPA Numbers (\$4M)

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Forest and Paper Product Vision (Cont'd)	<p>Stiffness, Fiber Optic Sensing System for Measurement of Paper Web Parameters, Refiner Disc Gap and Wear, CCD-Based Sensor Instrumentation for On-Line Measurement of Paper Web Properties, Rapid Chemical and Physical Characterization of Wood Chips and Paper, Automated Sorting of Recycled Raw Materials and On-Line Chip and Web Analysis (\$2.4M)</p> <p>RECYCLING: Stickies Control in Recycling Operations, Infrared Detection of Contaminants (\$0.5M)</p> <p>SUSTAINABLE FOREST MANAGEMENT: High-Yield Hardwood Species, High Intensity Forest Management, Marker Aided Selection Methods for Wood Property Traits, Molecular Analysis of Carbohydrate Regulation in Loblolly Pine, Model-Based Diagnosis of Soil Limitations to Productivity (\$1.3M) (\$10,843)</p>	<p>Hardwood Species, High Intensity Forest Management, Marker Aided Selection Methods for Wood Property Traits, Molecular Analysis of Carbohydrate Regulation in Loblolly Pine, Model-Based Diagnosis of Soil Limitations to Productivity (\$1.1M) (\$12,040)</p>	<p>ENERGY PERFORMANCE: Design and Demonstration of Multiport Cylinder Dryers, High-Speed Microwave Treatment for Rapid Wood Drying, Moisture Distribution and Flow During Drying of Wood and Fiber, Biological Augmentation of Kraft Recycle, Growth and Property Development of Convection Pass Deposits in Recovery Boilers (\$3.2M)</p> <p>SENSORS AND CONTROL: Ultrasonic Sensors for Paper Stiffness, Refiner Disc Gap and Wear, Rapid Chemical and Physical Characterization of Wood Chips and Paper, Contactless Real Time Monitoring of Paper Mechanical Properties, Real Time Wood Chip Moisture Content and Cross Direction Measurement of Web Caliper and Basis Weight by Magnetics (\$2.1M)</p> <p>RECYCLING: The Removal of Wax and Stickies from old corrugated containers, Acoustic Separation Technology (\$0.6M)</p> <p>SUSTAINABLE FOREST MANAGEMENT: High-Yield Hardwood Species, Model-Based Diagnosis of Soil Limitations to</p>

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Forest and Paper Product Vision (Cont'd)			Productivity, Dominant Negative Mutations of Floral Homeotic Genes for Sterility in Trees, Pine Gene Discovery Project, Molecular Physiology of Nitrogen Allocation in Poplar, Sustaining the Productivity and Function of Intensively Managed Forests, Assessing the Significance of Below Ground Carbon Allocation of Fast and Slow Growing Families of Loblolly Pine, What Causes the Density Effects in Young Forest Plantations, Trees Containing Built-in Pulpig Catalysts (\$1.7M) (\$12,076)
	\$ 10,843	\$ 12,040	\$ 12,076
Steel Vision	The U.S. steel industry employs 170 thousand Americans in jobs paying 50 percent more than the average for all manufacturing. Steel is the most widely used engineering material in manufacturing, and forms the backbone of the infrastructure that defines our society, from silos to skyscrapers, from railroads to highway bridges, and from pipelines to supertankers. Steel is the most recycled of all materials.	In FY 1998, R&D activities continue to be responsive to the three critical areas defined in the steel industry vision, and will be prioritized and guided by the steel industry's technology roadmap. Significant benefits to steelmaking casting, rolling, and coating operations will be achieved by incorporating previously developed advanced process controls into those operations.	In FY 1999, the collaborative R&D partnership between the steel industry and DOE continues. R&D activities responsive to the three critical areas of production efficiency, iron-unit recycling, and environmental engineering of the Steel Industry's Vision of the Future will continue. The R&D will be both guided and prioritized by the Steel Industry Technology Roadmap.

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Steel Vision (Cont'd)	<p>The steel industry recycles nearly 55 million tons of scrap annually producing more than 50 percent of all steel from recycled material.</p> <p>This program will focus its strategies and its R&D in concert with the steel industry's vision of its future as described in "Steel: A National Resource for the Future" which identifies four critical areas requiring continuous improvement to retain steel's position as the material of choice for the 21st century. In DOE's R&D Compact with the steel industry, signed on May 2, 1995, DOE committed itself to collaborate in three of those critical areas: production efficiency, recycling, and environmental engineering.</p> <p>Based upon the steel industry's strategic vision of its future as described in "Steel: A National Resource for the Future," the industry is producing a tactical plan which will provide the essential technology roadmap for future steel R&D activities both public and private.</p>		<p>Significant benefits to steelmaking casting, rolling, and coating operations will be achieved by incorporating previously developed advanced results from Metals Initiative funded projects on process controls into those operations.</p> <p>Other significant benefits will accrue to the steel industry as it incorporates the results of projects funded from sources other than that of Metals Initiative. Projects previously incorporated under the Steel Vision from Advanced Industrial Materials, Combustion Program, NICE3, and the Environmental Technology Partnership (ETP) will have started commercialization activities and will begin to benefit the industry.</p>

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Steel Vision (Cont'd)	<p>In FY 1997 R&D activities were initiated that focused on three critical areas as identified in DOE's R&D compact with the steel industry: production efficiency, recycling, and environmental engineering.</p> <p>PRODUCTION EFFICIENCY: R&D efforts included the application of nickel aluminides (developed under the Advanced Industrial Materials Program) to steel forming and finishing operations. R&D on advanced process controls will improve energy efficiency and productivity in the U.S. steel industry by developing, testing, and commercializing selected sensors, control devices, and software to support steelmaking casting, rolling, and coating operations. (\$4,500)</p>	<p>PRODUCTION EFFICIENCY: Nickel aluminides will be tested in steel forming and finishing (rolling) operations at U.S. plant host sites.</p> <p>R&D will continue on advanced process controls to improve energy efficiency and productivity in the U.S. steel industry by developing, testing, and commercializing selected sensors, control devices, and software to improve the efficiency of such basic steel processes as the blast furnace, basic oxygen furnace, and the electric arc furnace. Various process control modifications will also be developed and assessed under operating conditions to improved productivity and efficiency of these operations. Most tasks in the Advanced Process Control program are scheduled for completion in FY 1998, which accounts for the decreases from FY 1996. (\$3,704)</p>	<p>PRODUCTION EFFICIENCY: Continue collaborative R&D with The American Iron and Steel Institute (AISI) to improve the efficiency of steel making, casting, and rolling processes. R&D initiated in late FY 97 will be continued on subjects such as processes and techniques to remove residual elements, advanced casting technologies, and improved material properties. Application of high-temperature nickel aluminides to critical areas of steel making and forming operations (beyond steel rolls) will be made on an accelerated basis. Efforts in collaboration with the National Laboratory System, AISI and Steel Manufacturers Association (SMA) to identify and adapt nuclear and weapon systems related technologies previously developed at the National Labs</p>

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Steel Vision (Cont'd)	<p>RECYCLING AND ENVIRONMENTAL ENGINEERING: R&D on improved methods of recovering iron units, other metals (e.g., zinc, lead), and oil from by product residues and, in certain cases, hazardous wastes produced in iron making and steelmaking operations. (\$4,405</p>	<p>RECYCLING AND ENVIRONMENTAL ENGINEERING: R&D on methods to lower nitrogen oxide (NOx) and other emissions from combustion processes associated with steel production will be conducted.</p> <p>R&D will continue on improved methods of recovering iron units, other metals (e.g., zinc, lead), and oil from by product residues and, in certain cases, hazardous wastes produced in iron making and steelmaking operations.</p> <p>Methods of increasing the rate of steel scrap recycling from currently marginally tapped waste streams will be assessed and implemented. (\$6,022)</p>	<p>for industry use will continue. (\$3,827)</p> <p>RECYCLING AND ENVIRONMENTAL ENGINEERING: R&D on methods to lower NOx and other emissions from combustion processes associated with steel production will continue. Other R&D projects are responsive to the R&D needs identified in the chapters "Iron Unit Recycling" and "Environment" of the Iron and Steel Industry Technology Roadmap. This new R&D will provide material recycling and environmental improvements gained through efficiency and productivity increases in the steel production process. R&D on end-of-pipe concepts are specifically excluded.</p> <p>In collaboration with AISI, R&D will continue on improved methods of recovering iron units, other metals (e.g., zinc, lead), and oil from by product residues and, in certain cases, hazardous wastes produced in iron making and steelmaking operations. Continue</p>

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Steel Vision (Cont'd)			collaborative R&D with the Electric Power Research Institute (EPRI) to minimize electric arc furnace dust emissions.
		\$ 9,726	R&D on methods of increasing the rate of steel scrap recycling from currently marginally tapped waste streams will be continued. (\$6,800)
	\$ 8,905		\$ 10,627
Aluminum Vision	In 1990 the U.S. primary aluminum industry had shipments valued at \$23 billion, and was composed of 11 companies with only 3 retaining some research capability. In recent years the major companies have made extensive off-shore investments to exploit lower cost resources and operating costs. Leapfrog retrofitable metal production technologies for existing facilities and advanced manufacturing processes were critical to maintaining a viable domestic aluminum production and manufacturing industry.	The U.S. aluminum industry operates 300 plants in 40 states, employing 128,000 people, with a total payroll of more than \$4 billion. The U.S. aluminum industry consumes approximately 0.9 Quad of energy annually at a cost of over \$2 billion. The largest concentration of domestic aluminum shipments is in transportation, containers and packaging, and building and construction. As of 1994, the transportation market (24% of total 1994 shipments) is the largest user of aluminum. Recycling is a critical component of the industry; over one-third of the total industry supply of	To sustain a competitive advantage in the global marketplace into the 21st Century, the U.S. aluminum industry must maintain its leadership in energy efficiency, manufacturing processes and technologies, ecological sustainability, enabling technologies, information technologies, computational materials science, and multidisciplinary integration. Industry-wide performance goals include: reduce production costs by 25%, achieve significant costs reductions in aluminum for automotive applications, recycle and treat all types of aluminum wastes, achieve 80% wrought

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Aluminum Vision (Cont'd)	<p>Reduction of energy consumption and operating costs in the production of primary aluminum metal, retention of alloy purity in metal recycling and leapfrog process improvements are key elements in producing competitive aluminum products for increased use in downstream applications and attendant weight reduction benefits to U.S. industry: Aerospace, automotive, food and beverage packaging, electric transmission, consumer durables, machinery and equipment, building and construction.</p> <p>This program focused on the completion of the Aluminum Vision of the Future and the realignment of existing Aluminum production, recycling and fabrication programs to the technology needs and opportunities included in the Vision.</p> <p>Government R&D funds are synergistically leveraged with other federal and state agencies and industry to address the technology needs and opportunities identified in the</p>	aluminum now comes from recycled aluminum.	recycling of autos by 2004, eliminate emissions of carbon dioxide in the smelting process, decrease energy intensity from an average of 15 kilowatt hours per kilogram (kw-hr/kg) to 11 kw-hr/kg.

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Aluminum Vision (Cont'd)	<p>Aluminum Industry Vision of the Future and Technology Roadmap to ensure a viable U.S. aluminum industry in the world market. Benefits for this program include energy savings in primary aluminum production. The cost savings in metal production and fabrication will enable full utilization of aluminum in the transportation sector. Significant annual reduction in greenhouse emissions from metal production and the full implementation of aluminum in light weight vehicles will be realized. An additional benefit will be the many jobs generated/saved through cost reductions in the aluminum production industry. Implementation of the stable cathode technology will enable existing smelters to expand production capacity to meet the U.S. needs in 2010 without new smelter capital investments. All states are impacted with aluminum production and related automotive manufacturing centered in WA, TN, IL, IA, TX, CA, NY, NC, MI, OH, IN and PA. A scientific base will be initiated to ensure</p>		

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Aluminum Vision (Cont'd)	<p>future viability of U.S. aluminum industry.</p> <p>Partnerships will be formed with other government and state agencies, universities, national laboratories and industry to generate a synergism in government supported R&D to address the integration of upstream, process and downstream enabling technology needs and opportunities addressed in the Aluminum Technology Roadmap. Primary metal production R&D includes design of a full-scale low energy pilot cell, testing of an energy-efficient pressure calciner, and evaluation of industry commercialization of aluminum salt cake recovery process.</p> <p>R&D Activities: R&D in semifabricated production includes completion of a pilot test facility for spray formed automotive sheet metals. (Partnership for a New Generation Vehicle PNGV=\$1,000) R&D in the finished products area includes development and characterization</p>	<p>R&D Activities: Continue R&D partnerships to address technical challenges identified in the Aluminum Technology Roadmap. Research partnerships will address the needs of the primary, semifabricated, and finished product sectors of the Aluminum industry, as well as provide enabling technical support for the</p>	<p>R&D Activities: Continue support for R&D partnerships to address technical challenges identified in the Aluminum Technology Roadmap. Research partnerships will address the needs of the primary, semifabricated, and finished product sectors of the Aluminum industry, as well as provide enabling technical support for the industry in areas such as</p>

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Aluminum Vision (Cont'd)	<p>of an aluminum bridge deck system using multi-void extrusions joined together to make panel sections, for upgrading deficient bridges in the U.S.</p> <p>Aluminum partnerships will provide enabling technical support for the industry in arenas such as furnace design, modeling and control, and improvements in materials properties and processes. Advanced electrolysis process control sensors will provide 1-2% productivity gains in existing aluminum production cells and the improved bath composition control required for the commercial use of inert anodes in the advanced aluminum production cell capable of energy savings to 32% and production cost savings up to 30%. Innovative Concepts projects in aluminum are completed. (\$5,503)</p>	<p>industry in areas such as furnace design, modeling and control, and improvements in materials properties and processes.</p> <p>Core R&D will include completion of plant testing of sensors, evaluation of inert/stable electrode materials for primary aluminum production, and commercialization of an aluminum salt cake recovery process. Complete sprayforming pilot unit and optimize alloy and processing parameters to increase use of recycled aluminum in auto sheet products with reduced material and energy costs. (PNGV=\$1,000) (\$7,335)</p>	<p>process modeling, high-performance furnace designs, and improvements in materials properties and processes.</p> <p>Core R&D will include continued evaluation of inert/wettable electrode materials and advanced cell designs for primary aluminum production, development of semisolid forming techniques, and development of robust sensors and controls for harsh environments. Complete construction of the spray forming Advanced Development Unit and test the viability of the process to produce automotive aluminum sheet with reduced material, production, and energy costs. (PNGV=\$1000) (\$8,178)</p> <p>Execute research that aligns with the mining industry's technology roadmap. (\$1,000)</p>

\$ 9,178

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Aluminum Vision (Cont'd)	\$ 5,503	\$ 7,335	
Metal Casting Vision	<p>The research co-funded on an equal basis with industry has resulted in improvements in energy and raw material usage efficiency, process knowledge, and a reduction in environmental impacts. All of these impacts are dependent on the commercialization of the technologies developed and therefore increase into the future. The estimated results of this six year partnership with the metalcasting industry include. Energy: The metalcasting industry uses about 250 trillion Btu's of energy each year. Program research has resulted in an estimated yearly energy savings to the Nation of 5.3 Trillion Btu which relates to an annual cost savings in 1994 dollars of \$203 million. Environment: The Metal Casting Industry is the largest recycler in North America saving 13.3 million tons of scrap metal from disposal in landfills and junk yards each year. Scrap iron and steel are a major source of raw material for foundries. Program</p>	<p>The program focuses its strategy and R&D on high priority technologies as defined by the Metal Casting Industry Vision of the Future, Beyond 2000. The program maintains its focus and relevance through the partnership with the Cast Metal Coalition, which is composed of industry experts from the American Foundrymen's Society, North American Die Casting Association, and Steel Founders' Society of America, directly serving over 1,400 metalcasting companies, and indirectly serving more than 2,000 metalcasters in the United States, and its oversight by industry. Each project proposed is reviewed by the OIT metal casting team to priorities those with the strongest match to our energy, environmental, and economics goals for the Nation.</p>	<p>Continue R&D partnerships with the Cast Metal Coalition (CMC) to address the technical challenges identified in the Metalcasting Technology Roadmap. Benefits of the metalcasting R&D activities to the nation by year 2010 include: 1) increase of energy efficiency resulting in energy savings, 2) reduction of waste generation, and 3) increase in productivity. Technology transfer will also be effectively accomplished through the CMC, which is composed of industry experts from the American Foundrymen's Society, North American Die Casting Association, and Steel Founders' Society of America, directly serving over 1,400 metalcasting companies, and indirectly serving more than 2,000 metalcasters in the United States.</p>

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Metal Casting Vision (Cont'd)	<p>research has resulted in an estimated reduction of CO₂ emissions by almost 440,000 tons each year and SOx reduction of 2,000 tons each year.</p> <p>Industries Vision for Its Future The metal casting industry developed a comprehensive vision document called "Beyond 2000: A Vision for the American Metal casting Industry." As stated in Beyond 2000 "Metal casting will be the preferred supplier of net or near-net shape metal components beyond the year 2000. Its globally competitive products will be produced in an efficient, environmentally friendly manner." The key challenges for the metal casting industry as described in their vision include: the development of advanced manufacturing technologies to increase productivity 15%, reduce average lead times 50%, and reduce energy consumption 3-5%; Develop environmental technologies to achieve 100% pre- and post-consumer recycling; 75% beneficial re-use of foundry by-products, and the complete elimination of waste streams. Beyond2000 allows for the</p>		

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Metal Casting Vision (Cont'd)	<p>focusing and leveraging of federal funds and resources toward technologies critical to the metal casting industry and which completely eliminates waste streams. The partnership between the metal casting industry and DOE will continue to be successful and was renewed by the signing of a compact between the Secretary of Energy and the Metal Casting Industry in October of 1995 and is destined for continued success.</p> <p>The program focuses its strategy and R&D on high priority technologies as defined by Beyond 2000 so that industry can transfer research results to the metal casting shop-floor; and to establish centers for conducting Metal casting Research. Research conducted under this program requires significant industry participation and an equal match for each Federal dollar invested.</p> <p>The program focuses its strategy and R&D on high priority technologies as defined by the Metal Casting Industry Vision, Beyond 2000, so that industry can transfer research results to the</p>		

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Metal Casting Vision (Cont'd)	<p>metal casting shop-floor; and to establish centers for conducting Metal casting Research. Research conducted under this program requires significant industry participation and an equal match for each Federal dollar invested. This portfolio of near-, mid-, and long-term projects supports Beyond 2000 and furthers the national goals of reduced energy consumption, environmental responsibility, resource efficiency, and a strong national manufacturing base.</p> <p>R&D Activities: Continue projects that demonstrate continued technical success. Continue research on the critical technology needs identified in Beyond 2000 and the metal casting technology roadmaps with guidance by the partnerships with the Cast Metals Coalition. Provide continued support for 8 of the 13 projects started in FY96 and co-fund about 10 projects that are focused on the key challenges identified in Beyond 2000. Planned project areas include "Unconventional Methods for Yield Improvement through Directional Solidification in Steel</p>	<p>R&D Activities: Continue funding of 7 projects started in FY96 that demonstrate continued technical success.</p> <p>Continue balancing the research portfolio to provide results in the time frames identified by industry in the technology roadmaps for each sector of the metal casting industry.</p> <p>Continue the research development partnerships with the Cast Metals Coalition on the critical technology needs</p>	<p>R&D Activities: Continue to maintain a balanced portfolio of high priority projects in meeting the challenges identified in the MetalcastingTechnology Roadmap, which will benefit each sector of the metalcasting industry. The continued present-funded projects from previous years' solicitations include the following educational institutions: University of Alabama-Tuscaloosa, University of Alabama-Birmingham, Ohio State University, Worcester Polytechnic Institute, Case</p>

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Metal Casting Vision (Cont'd)	Castings," "Impurity Limits in Aluminum Bronzes," "Clean Machinable, Thin-Walled Gray & Ductile Iron," "High Speed Milling," "Yield Improvements," "Wear Analysis of Foundry Tooling Materials," "Clean Metal Casting," "Cupola Neural Network Model & Feedback Control" (\$3,399)	identified in Beyond 2000. Planned project areas include: "Lost Foam Process Development," "Evaluation of Coatings for Die Resistance," "Sensors for Die Casting," and "Thin wall castings for light weight components." Technologies in thin wall casting also targets the automotive market with strong recyclable cast components which would offset the use of other more expensive metals. The benefits of this project include reduced energy consumption in the iron casting process, transportation fuel savings in automobile applications and 50% reduction in machining scraps. (\$5,480)	Western Reserve University, Penn State University, University of Wisconsin-Milwaukee, University of Michigan, and University of Iowa. Manufacturing Technologies: Planned activities that will improve energy efficiency, casting productivity, and quality include: 1) Computer Modeling efforts, e.g. "Computer Modeling of Short Sleeves," 2) Advances in Semi-Solids Metal Processing technologies, e.g. "Semi-Solid Metal Processing" and "Properties of Squeeze and Semi-Solid Metal," 3) Advances in Metal Cleanliness, e.g. "Clean Metal Casting" and "Clean Cast Steel," and 4) Advances in Thin-Wall Casting, e.g. "Thin Section Steel Castings" and "Thin-Wall Iron Casting." Tools and new sensors will also be developed to improve die-cavity filling for higher quality castings, extend die life, and minimize part distortion for die-casting process used for aluminum, magnesium, and zinc alloys, e.g. "Sensors for Die Casting" and "Evaluation of Coatings for Die Wear Resistance." Examples of other

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Metal Casting Vision (Cont'd)			<p>process improvement activities include: "Advances in Lost Foam Process Development" and "Heat Transfer Permanent Mold Aluminum Alloys."</p> <p>Materials Technologies: Activities are focused on Advancing the Use of New and Improved Materials for Castings, e.g. "Cast Particulate Metal Matrix Components" and "Clean, Machinable, Thin-Wall Iron Casting Production."</p> <p>Environmental Technologies: Begin developments in new waste characterization, reduction, reuse, and alternate use of foundry waste. (\$5,797)</p>
	\$ 3,399	\$ 5,480	\$ 5,797
Glass Vision	<p>Glass is an important component of the U.S. economy, employing 150,000 people in skilled jobs, and generating more than 21 million tons of consumer products annually at a value of \$22 billion in optical fibers to windshields to medicinal vessels. Manufacturing</p>		

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Glass Vision (Cont'd)	<p>lines ranging from 650 ton/day float lines to hand glass day tanks feel increased competition from alternate materials and lower R&D resources at 1.75% of sales where capital intensity is 5.2% of annual sales with lifetimes of furnaces beyond 10 years. Energy cost is running an average of 12% across the sectors of container, flat, fiberglass, and specialty glass. This highly competitive, capital-intensive industry (\$100 million to build a facility) requires a cultural transition to leveraging between members of its community, which this federal strategy solely provides.</p> <p>The focal points of the industry's vision, Glass: A Clear Vision for a Bright Future, are meeting targets by 2020 in the areas of: production efficiency, energy efficiency, environmental protections, recycling, and innovative uses. Projects shall be identified that are key priorities for the industry, such as development of refractory materials, oxygen fuel optimization, and modeling of furnace operation. These</p>		

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Glass Vision (Cont'd)	<p>technologies shall be developed in partnership with industry to be commercialized by them to move the whole industry forward in improving the Nation's technology balance, reducing fuel consumption, and improving environmental compliance.</p> <p>Goals as stated by the industry include: production costs reduced at least 20% below 1995 levels; recycling 100% of all glass products in the manufacturing process; reducing process energy use from present levels resulting in major cost savings; reduction of air/water emissions by a minimum of 20% through environmentally sound practices; increased recycling of available post consumer glass; achieve six sigma quality through automation, process control, optimized glass composition, and computer simulation; create innovative products and broaden the marketplace; and increase supplier and customer partnerships in raw materials, equipment, and energy improvements in 2020.</p> <p>R&D Activities Include:</p>		

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Glass Vision (Cont'd)	<p>PRODUCTION EFFICIENCY: Continuation of Molybdenum Disilicide as a Coating and Structural Component in Glass Furnaces, Initiation of New Alloy Development, Initiation of Refractory Materials and Creep Assessment, Modeling Properties Assessment of Glass Characteristics; ENERGY EFFICIENCY/ CONSERVATION: Completion of Air Enriched Air Staging, Completion of Oxy-Fuel Problems Workshop, Continuation of Advanced Combustion Space Modeling; ENVIRONMENTAL PROTECTIONS: Continuation of High Heat Transfer/Low Emissions Gas Combustion System; RECYCLING: Continuation of Cullet/Batch Preheater, Cullet Preparation and Contaminant Removal; INNOVATIVE USES: Continuation of Chemical Vapor Deposition; DEPLOYMENT LOGISTICS: Completion of Benchmarking Assessment. (\$2,917)</p>	<p>R&D Activities Include: PRODUCTION EFFICIENCY: Completion of Molybdenum Disilicide as a Coating and Structural Component in Glass Furnaces, Continuation of New Alloy Development, Continuation of Refractory Materials and Creep Assessment, Initiation of Advanced Sensor, Modeling, and Properties Development; ENERGY EFFICIENCY/ CONSERVATION: Completion of Advanced Combustion Space Modeling, Initiation of Optimized Electric Boost; ENVIRONMENTAL PROTECTIONS: Completion of High Heat Transfer/Low Emissions Gas Combustion System, Initiation of Non-Hazardous Waste Refractory Materials, Initiation of Solid Waste Reuse in Glass Manufacture; RECYCLING: Completion of Cullet/Batch Preheater, Continuation of Cullet Preparation and Contaminant Removal; INNOVATIVE USES: Completion of Chemical Vapor Deposition;</p>	<p>R&D Activities Include: PRODUCTION EFFICIENCY: Initiation and/or continuation of new projects started in FY 98 in the following areas: controls for process optimization for desired glass properties; contact and non-contact sensors for glass physical properties, heat flux, furnace refractory thickness and temperature, on-line stress measurements; and process simulation models that actually simulate the glass manufacturing process. Completion of new alloy development and creep assessment. ENERGY EFFICIENCY/ CONSERVATION: Initiation and/or continuation of new projects started in FY98 in the following areas: glass furnaces with lower net production cost; in-situ testing of furnace refractories; and combustion laboratory characterization of flames from different burner configurations. Continued development of optimized electric boost. ENVIRONMENTAL PROTECTIONS AND RECYCLING: Initiation and/or</p>

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Glass Vision (Cont'd)		DEPLOYMENT LOGISTICS: Completion of Coating & Composition Workshop. (\$3,883)	continuation of new projects started in FY98 in the following areas: improved oxy-fuel firing technology to reduce air emissions; alternate raw materials, batch preparation, and/or furnace designs with lower particulate and gaseous emissions; improved sorting and preparation of post-consumer waste. Completion of non-hazardous waste refractory materials and solid waste reuse. INNOVATIVE USES: Initiation and/or continuation of new projects started in FY98 in the following areas: innovative glass compositions and processes to enhance performance; new material-design models to improve properties; and enabling technologies that allow new and innovative uses of glass. DEPLOYMENT LOGISTICS: Conduct two (2) technical workshops. Conduct technology roadmap assessment. (\$4,830)
	\$ 2,917	\$ 3,883	\$ 4,830
Chemicals Vision	The chemical industry employs over one million people in the	Benefits of these activities will result in improved productivity,	

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Chemicals Vision (Cont'd)	<p>U.S. It has sales of over \$313 billion, of which \$45 billion represents exports. Over 91% of the 10,000 companies in this diverse industry have fewer than 100 employees. It is the second largest energy consumer and the largest generator of waste in the manufacturing sector. Downsizing and global market pressures have forced re-deployment of resources to address critical short term needs so the industry can no longer afford to fully assume the financial risk associated with long-term revolutionary R&D.</p> <p>The balanced OIT R&D portfolio is aligned with the Chemical Industry Technology Vision 2020 functional structure. Industry has identified four critical technical areas: New Chemical Science and Engineering Technology, Computer Utilization & Information Management, Manufacturing Operations, and Supply Chain and Logistics. Technologies developed in partnerships with industry will be commercialized by industry, improving the Nation's balance of</p>	<p>increased energy efficiency, and significant reduction in process wastes. The chemical program is aligned with large and small private companies, using the unique resource of the National Laboratory System and U.S. universities. Jobs saved or retained exceed 14,000 person years in 2010.</p>	

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Chemicals Vision (Cont'd)	<p>payments, reducing oil imports, improving the environment and creating new high paying jobs.</p> <p>R&D activities within the Vision 2020 structure include: NEW CHEMICAL SCIENCES AND ENGINEERING: New chemical science and engineering is the fundamental driver of advances within the chemical industry. This area of R&D includes chemical synthesis, bioprocesses, materials development, process science, chemical measurement and computational technologies. Projects include commercialization of technologies for wood waste to adhesive and plant starch to plastics. (\$8.8M) COMPUTER UTILIZATION & INFORMATION MANAGEMENT: e.g. Complete OIT's contribution to computer models of environmental effects of processing: (\$0.183M) MANUFACTURING OPERATIONS: e.g. Initiate field testing of technology for membrane separation of chlorinated wastes. (\$1.0M) (\$9,983)</p>	<p>R&D activities within the Vision 2020 structure include: NEW CHEMICAL SCIENCES AND ENGINEERING: New chemical science and engineering is the fundamental driver of advances within the chemical industry. This area of R&D includes chemical synthesis, bioprocesses, materials development, process science, chemical measurement and computational technologies. Projects include completion of polyphosphazene membrane test of pallet-sized membrane system at an industrial site to familiarize industry with technology. The bio-process for di-acid production will be scaled-up to an intermediate size to collect basic operating data and obtain process performance data prior to a full-scale pilot plant demonstration. (\$10.614M) MANUFACTURING OPERATIONS: e.g. Support R&D identified in the Chemical Industry Technology Vision 2020</p>	<p>R&D activities within the Vision 2020 structure include: NEW CHEMICAL SCIENCES AND ENGINEERING: New chemical science and engineering is the fundamental driver of advances within the chemical industry. This area of R&D includes chemical synthesis, bioprocesses, materials development, process science, chemical measurement. Support R&D identified in the chemical industry roadmaps including catalysis, bioprocesses, and separations. (\$10.492M) Execute research in biobased renewable feedstocks which supports the Agriculture vision. (\$2.0M) COMPUTER UTILIZATION AND INFORMATION MANAGEMENT: Support R&D identified in the chemical industry roadmap on computational fluid dynamics and chemistry. (\$1.0 M) MANUFACTURING OPERATIONS: Support R&D</p>

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Chemicals Vision (Cont'd)	\$ 9,983	with industrial partners such as the Center for Waste Reduction Technologies. (\$1.0M) (\$11,614)	identified in the Chemical Industry Technology Vision 2020 with industrial partners such as the Center for Waste Reduction Technologies. (\$1.0 M) (\$14,492)
		\$ 11,614	\$ 14,492
Petroleum Refining Vision	The Petroleum Refining (SIC 2911) industry is critical to the economic stability and energy security of the United States. The annual value of all product shipments from the petroleum refining industry is about \$136 billion. The industry supplies 97% of the transportation fuels for the nation. This industry is facing major restructuring in response to international competition and the requirements to meet the Clean Air Act Amendments of 1990. In response to these immediate needs, the industry is unable to maintain its financial commitment to high risk R&D. The industry consumes about 6 quads annually, and produces 180 million tons/yr. of wastes. There are 163 refineries situated in 35 states,	Research activities with the Petroleum Refining industry were brought to an orderly close during FY98, due to the industry's reluctance to proceed with the development of an industry vision and technology roadmaps. (\$3,000)	No Activities. (\$0)

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Petroleum Refining Vision (Cont'd)	<p>with California, Texas and Louisiana representing 80 refineries. The industry employment is 77,000.</p> <p>The Petroleum Refining program is a strategic response to the needs of this industry, as defined by multiple industry inputs including a Workshop report and a National Petroleum Council study. The program is conducted in partnership with industry and addresses these research priority areas: Environmental & Safety Performance; Process Improvement; Enabling Technologies; and Feedstock Flexibility and Product Characterization.</p> <p>R&D Activities include: ENVIRONMENTAL & SAFETY PERFORMANCE: Very Low Emission Burners; (\$0.98M) PROCESS IMPROVEMENT: High Pressure Heat Exchanger for Ethylene Production; (\$0.75M) ENABLING TECHNOLOGIES: Advanced Fluid Catalytic Cracker, Fouling Mitigation, Improved Refining Catalysts; (\$1.052M)</p>		

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Petroleum Refining Vision (Cont'd)	<p>FEEDSTOCK FLEXIBILITY/PRODUCT CHARACTERIZATION: Removal of Sulfur from Petroleum Products. (\$1.0M)</p> <p>A specific R&D example is Advanced Fluid Catalytic Cracker (FCC). The U.S. consumes annually about 22 quads of transportation fuels, with more than 40% of all gasoline produced by the FCCs. The FCC project targets a 7% improvement in yield in the processing of crude oil to produce these fuels. (\$3,782)</p> <p>\$ 3,782</p>	<p>\$ 3,000</p>	<p>\$ 0</p>
Industry-Wide Solicitation	No Activities. (\$0)	No Activities. (\$0)	<p>INDUSTRY-WIDE SOLICITATION: A competitive solicitation will be conducted which will focus on reducing the generation of climate change gases, and increasing energy efficiency in the industrial sector. These items will, in turn, result in higher productivity at the plant level, and increased or sustained jobs. This solicitation will be open to all industries, with</p>

III. Performance Summary: INDUSTRIES OF THE FUTURE (SPECIFIC) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Industry-Wide Solicitation (Cont'd)			emphasis on those industries which have developed industry-wide visions and associated roadmaps to develop advanced technologies to improve their environmental and energy performance. Proposals will be selected which will have the most impact on climate change gases, especially including non-CO ₂ greenhouse gases and energy efficiency and which will have widespread applicability in industry. The solicitation will be scheduled in order to make contract awards early in the fiscal year, in order to reduce uncostered obligations. At the proposed level of funding, research on roughly 40 new technologies might be initiated, which could eventually lead to a reduction of carbon emissions on the order of 10 million metric tons and several trillion Btus of energy. Productivity gains of 5% could be expected. (\$19,000)
	\$ 0	\$ 0	\$ 19,000
Industries of the Future (Specific) Total	\$ 45,332	\$ 53,078	\$ 76,000

INDUSTRIAL TECHNOLOGIES
INDUSTRY SECTOR
(dollars in thousands)

INDUSTRIES OF THE FUTURE (CROSSCUTTING)

I. **Mission Supporting Goals and Objectives:**

A. Statement of Mission:

Crosscutting Technologies address the problems common to all of the Vision Industries. The planning units include Cogeneration/Advanced Turbine Systems, Continuous Fiber Ceramic Composites/Advanced Industrial Materials, and Combustion/Sensors. An efficient use of R&D resources is gained by dealing with these common problems in specialized programs.

Cogeneration is the concurrent production of two forms of energy (e.g., electricity and steam) from the same fuel source, typically using the exhaust from one system as the input for the other. Cogeneration system efficiencies can reach as high as 80% and produce much less pollution than conventional systems.

The Advanced Turbine Systems (ATS) Program will develop and demonstrate the next generation of gas turbines for both utility and industrial applications, including cogeneration and combined heat and power. The goals of the ATS program are to improve the efficiency (15% increase) and environmental performance (80% reduction in emissions) of gas turbines while reducing the cost of electricity by 10%. These goals will be met through advancements in engine system and component design, including innovations in cooling, materials, and coatings. The environmental goals will require the use of new combustion techniques including ceramics and catalytic combustion.

U.S. industry has a critical need for high performance materials that improve productivity, product quality, and energy efficiency in industrial products and the major process industries. Ceramic materials offer superior performance in energy intensive processes, but are often too brittle for many operations. The goal of the Continuous Fiber Ceramic Composite (CFCC) Program is to overcome these limitations with new material systems. The Advanced Materials Program is focusing efforts on the development of materials with high temperature strength and fatigue resistance, improved corrosion resistance, and better wear resistance.

The CFCC Program operates as a collaborative effort between industry, national laboratories, universities and the government to develop advanced composite materials to a point at which industry will assume the full risk of further development. There are currently six industry teams comprising 51 members (led by AlliedSignal, Babcock & Wilcox, Dow Corning, DuPont Lanxide, General Electric, and Textron) developing more than 20 applications for continuous fiber ceramic composite materials. The National Laboratories, led by **Oak Ridge National Laboratory**, are developing supporting technologies (e.g., material design, processing methods, manufacturing techniques) and conducting performance evaluations.

I. **Mission Supporting Goals and Objectives:** INDUSTRIES OF THE FUTURE (CROSSCUTTING) (Cont'd)

The Advanced Materials Program supports the joint DOE/industry vision programs through several activities. Projects include: the development of nickel aluminides to make steel mill and foundry equipment last longer; molybdenum disilicide and other materials for longer glass melting furnaces; and polymer processing methods for better plastic products. Specific activities continue on intermetallic alloy development, including nickel, iron, and titanium aluminides. For example, a project was initiated to develop improved composite tubes for boilers used by most paper manufacturers. Other activities include development of ceramic processing methods, metal matrix composites by innovative methods, and improvement of properties of polymers.

The goal of Combustion activities is to maximize efficiency and minimize emissions at the lowest practical cost. The ongoing implementation of clean air regulations and relatively low fuel prices have shifted industrial concern, and consequently program emphasis, to low-cost approaches to reducing air pollution emissions from industrial combustion sources. Combustion activities at OIT are driven by the needs of industry and guided by end-user experts from industry, academia, and national laboratories. The program is designed to move superior combustion concepts from the laboratory through industry host site demonstration resulting in commercialization. All projects are cost-shared with industry partners. A distinct record of success and maximum results for the taxpayer dollar are hallmarks of OIT combustion activities. Oxy-fuel combustion, first demonstrated under OIT combustion sponsorship, is now operating on over 20 percent of U.S. glass production capacity. The combustion program concentrates on projects which span more than one industry need. All of the Industries of the Future rely on combustion of fuels to achieve process goals and must deal with the emissions which result from combustion. The program develops methods to improve boilers, furnaces, and burners for the target industries. The program also works to coordinate combustion with improved sensors and controls for optimization of operation and emissions controls.

B. Program Benefits

	2000	2010	2020
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Total Primary Energy Displaced (quads)	.01	.30	.68
Energy Cost Savings (\$billions)	.02	.92	1.96
Carbon Reductions (million metric tons)	.10	4.55	10.08

Productivity improvements could result in other cost savings equal to or greater than the energy cost savings.

C. Performance Goals

The Strategy/Goal for 2001 for the Advanced Turbine Systems program is for commercial introduction of gas turbines that will:

- increase efficiency from 29% to 43%.
- lower Nitrogen Oxide (NOx) emissions to less than 8 ppm.

I. **Mission Supporting Goals and Objectives:** INDUSTRIES OF THE FUTURE (CROSSCUTTING) (Cont'd)

- lower Carbon Monoxide (CO) and unburned hydrocarbons to less than 20 ppm.
- reduce the cost of electricity by 10%.
- encourage the expanded use of cogeneration.

D. Accomplishment Summary:

FY 1997

- Completed ATS subsystem engine design and testing.
- Demonstrated representative components including high temperature filters, hot gas filters, and submerged aluminum melters.
- Completed Phase II, feasibility testing activities of most applications, in the CFCC program.
- Completed large-scale testing of nickel aluminide trays and fixtures for carburization of steel components.
- Developed six new applications for nickel, iron, and titanium aluminide in the major process industries.
- Completed development of new processes for production of metal matrix composites for high temperature applications.
- Identified reasons for whirl burner low NO_x.
- Determined limiting heat transfer step in black liquor gasification process.

FY 1998

- Complete Ceramic Stationary Gas Turbine field test (2000 hr) at 1850 degrees F.
- Complete single crystal gas turbine blade castings development.
- Initiate thermal barrier coating bench-scale testing.
- Complete ATS full-scale engine tests.
- Prepare for first field evaluation of ATS engines.

I. **Mission Supporting Goals and Objectives:** INDUSTRIES OF THE FUTURE (CROSSCUTTING) (Cont'd)

- Deploy nickel aluminide to all segments of industry.
- Minimize whirl burner CO levels.
- Determine if black liquor fuel gas can be used in pulse combustor.
- Reconcile differences between fuel gas recirculation modeling and experimental results.

FY 1999

- Initiate Phase IV thermal barrier coatings development in ATS.
- Complete ATS combustion testing.
- Continue deployment of nickel aluminide to all segments of industry.
- Develop new iron aluminide materials for die casting, and boiler tube applications.
- Complete submerged aluminum melter tests of CFCC's.
- Complete whirl burner scoping, prepare package for transfer of technology to industry.
- Produce complete explanation of effectiveness of fuel injection recirculation.
- Extend oscillating combustion to rotary hearth furnace.

II. A. Funding Table: INDUSTRIES OF THE FUTURE (CROSSCUTTING)

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	\$ Change	% Change
Cogeneration	\$ 24,157	\$ 34,650	\$ 33,000	\$ -1,650	-5%
Advanced Materials and CFCCs	14,221	14,470	14,400	-70	0%
Combustion Technologies	0	0	2,000	2,000	>999
Total, Industries of the Future (Crosscutting)	<u>\$ 38,378</u>	<u>\$ 49,120</u>	<u>\$ 49,400</u>	<u>\$ 280</u>	<u>1%</u>

II. B. Laboratory and Facility Funding Table: INDUSTRIES OF THE FUTURE (CROSSCUTTING)

Ames Lab	\$ 50	\$ 0	\$ 0	\$ 0	0%
Argonne National Lab (East)	205	275	275	0	0%
Los Alamos National Laboratory	1,400	1,100	1,100	0	0%
Oak Ridge National Lab	7,073	7,410	7,350	-60	-1%
Sandia National Laboratories	760	750	750	0	0%
All Other	28,890	39,585	39,925	340	1%
Total, Industries of the Future	<u>\$ 38,378</u>	<u>\$ 49,120</u>	<u>\$ 49,400</u>	<u>\$ 280</u>	<u>1%</u>

III. Performance Summary: INDUSTRIES OF THE FUTURE (CROSSCUTTING)

Activity	FY 1997	FY 1998	FY 1999
Cogeneration	<p>Continue the industrial and utility Advanced Turbine Systems (ATS) program activities including design, manufacture and testing of full-scale components and integrated subsystems. Preparations for 8000 hour field demonstrations commenced. Complete preliminary engine designs. (\$16.5M) Complete retrofit of Gas Turbine Ceramic Retrofit field test engine. Commence 4000 hour field test at the cogeneration site in Bakersfield, CA. Pre- and post-testing component evaluation and characterization commenced. (\$3.5M) Complete field evaluation of three turbines equipped with Ultra-Low NOx technology. (\$0M) Continue enabling materials support program including scale-up of single crystal turbine castings and improved Thermal Barrier Coatings. (\$4.0M) (\$24,157)</p>	<p>Continue the industrial and utility Advanced Turbine Systems (ATS) program activities including design, manufacture and field testing of full-scale components and integrated subsystems. Complete engine detail designs. Continue turbine and compressor rig testing. Commence first engine builds. Evaluate the market of ATS for distributed generation applications. (\$24.5M) Complete 2000 hour Gas Turbine Ceramic Retrofit field test at the cogeneration site in Bakersfield, CA. Continue pre-and post-testing component evaluation and characterization. (\$4.0M) Continue enabling materials support program including scale-up of single crystal turbine casting and improved Thermal Barrier Coatings. Complete melt desulfurization technology development for turbine castings. Complete Phase III for Thermal Barrier Coatings projects. Continue development of catalytic combustion technologies for reduced emissions in</p>	<p>Continue the industrial Advanced Turbine Systems (ATS) program activities including manufacture and field testing of full-scale components.</p> <p>Commence first industrial scale engine builds and initiate full-scale testing. Continue ceramic insertion program for industrial turbines, including microturbines. (\$23.0M) Complete post-testing component evaluation and characterization. (\$4.0M) Continue enabling materials support program including scale-up of single crystal turbine casting and improved Thermal Barrier Coatings. Initiate Phase IV of thermal barriers coatings. Continue to identify defect tolerance limits and alternative casting technologies. (\$4.0M) (\$31,000)</p>

III. Performance Summary: INDUSTRIES OF THE FUTURE (CROSSCUTTING) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Cogeneration (Cont'd)	No Activities. (\$0)	industrial gas turbines. (\$6.0M) (\$34,650) No Activities. (\$0)	Initiate combined heat and power (CHP) challenge program for improved deployment of CHP systems. (\$2,000)
	\$ 24,157	\$ 34,650	\$ 33,000
Advanced Materials and CFCCs	Continue Phase II activities to improve engineering and material processing methods and continue fabrication and testing activities. Most industrial participants will complete Phase II feasibility testing activities this fiscal year and begin demonstration of representative components. Demonstrated components will include diesel valve guides, submerged aluminum melters, burners and filters. Continue tests of materials and representative components in gas turbine, coal exhaust, electric motors, and combustion environments. (\$6.1M) Continue to develop supporting technologies (such as interfaces, joining, fibers, standards), conducting performance evaluations, and developing design methods for CFCC	Continued long term field demonstration and testing of components, environmental exposure of components, material analysis, data collection and database establishment. Continued long term tests of representative components in gas turbine, coal exhaust, and combustion environments. Begin some pilot scale process development activities. Begin batch production of burners, diesel valve guides and filters. (\$6.4M) Continue work on conducting performance evaluations, test methods, fiber interfaces, coatings, joining, design standards, and materials needs assessments. (\$2.0M) Continue to coordinate CFCC research with OIT's Vision Industries, DOE, DoD, NASA,	Continued long term field demonstration and testing of components, environmental exposure of CFCC components, material analysis, data collection and database establishment. Continued long term tests of representative components in gas turbine, coal exhaust, and combustion environments. Continue pilot scale process development activities. Continue batch production of burners, diesel valve guides, combustor linings, and filters. (\$6.4M) Continue work on performance evaluations, test methods, fiber interfaces, coatings, joining, design standards, and materials needs assessments. (\$2.0M) Continue to coordinate CFCC research with OIT's Vision Industries, DOE, DoD, NASA, and others. (\$8,400)

III. Performance Summary: INDUSTRIES OF THE FUTURE (CROSSCUTTING) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Advanced Materials and CFFCs (Cont'd)	<p>components. (\$2.0M) Continue to coordinate CFCC research with OIT's Vision Industries, DOE, Department of Defense (DOD), National Aeronautics and Space Administration (NASA), and others. (\$8,160)</p> <p>For FY97 and future years some mature projects were transferred to the industrial vision areas. This included two nickel aluminide projects for steel, a molybdenum disilicide project for glass, and a polymer processing project for chemicals. Work will continue on materials processing including composite tubes for Kraft boilers, ceramic process development, polymers for membranes, and commercialization of processes for magnetic field treatment of organic polymers. (\$6,061)</p>	<p>and others. (\$8,400)</p> <p>Identification of new industrial applications for nickel, iron, and titanium aluminides will be made and applications engineering will be done to adapt these materials to those uses. Development of new iron-chromium alloys for contact with molten glass will be continued, as will development of new coatings for flat glass, and new chromium silicides will be tested in industrial applications. The process for polymerization of plastics in magnetic fields will be transferred to the Chemical Industry Vision for commercialization. Work to develop superior gas separation membranes using liquid crystal polymers will be continued. Development of composites by molten metal infiltration will be continued, with emphasis on intermetallic alloy matrices. Work will continue on uniform metal droplets, with emphasis on high</p>	<p>Following on successful identification of new industrial applications for, and demonstration of, nickel and iron aluminides in FY 1997, the effort will continue, at an accelerated pace, to deploy these materials in a wider range of applications over all the Vision Industries. Additional work will be done on titanium aluminides, which have superior specific strengths at high temperatures, in order to ready them for industrial trials. Development of chromium silicides, iron-chromium alloys, and iron-chromium-silicon alloys for molten glass contact applications and uses in corrosive atmospheres in the chemical and refinery industries will continue and new applications will be identified. CRADAs with Dow Chemical and Amoco, to develop superior organic and inorganic membranes for gas and liquid</p>

III. Performance Summary: INDUSTRIES OF THE FUTURE (CROSSCUTTING) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Advanced Materials and CFFCs (Cont'd)		temperature alloys, steel, and aluminum for the primary metals and powder metals industries. (\$6,070)	separations and an electrochemical reaction cell for improvement of energy efficiency in the chloralkali process, will be completed. Development of metal matrix composites by reactive metal infiltration, under terms of a CRADA with Reynolds Metals and A.P. Green Industries, will be continued, with completion scheduled for FY 2000. Work will continue on uniform metal droplets and spray coatings, with emphasis on high temperature alloys, steel, and aluminum, for the primary, secondary, and powder metallurgy industries. Industrial trials will continue and new applications will be identified. (\$6,000)
	\$ 14,221	\$ 14,470	\$ 14,400
Combustion Technologies	In FY97 some combustion projects were concluded. Prior year funds were used to continue whirl burner scoping and benefits analysis of black liquor gasification process with technology transferred to manufacturer. Other projects continued in vision areas as requested by specific industries. (\$0)	Prior year funds were used to continue whirl burner scoping, fuel gas recirculation investigation and benefits analysis of black liquor gasification process with technology transferred to manufacturer. Other projects continued in vision areas as requested by specific industries. (\$0)	Complete whirl burner scoping with transfer of technology to industry. Continue pre-competitive fuel injection recirculation research to determine why this procedure is more effective than flue gas recirculation. In conjunction with glass, steel and metal casting activities demonstrate oscillating combustion in additional

III. Performance Summary: INDUSTRIES OF THE FUTURE (CROSSCUTTING) (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Combustion Technologies (Cont'd)			equipment types, continue development of efficient low cost heat exchanger system for power generation. For FY99 the combustion program will examine industrial boilers, process heaters and furnaces in the seven industries for cross-cutting impacts. Integration of combustion and sensors technologies will improve industrial performance and reduce emissions. Emphasis will be on low emissions, high efficiency, and remote sensing for high temperature, corrosive systems. Synergies between the vision industries will be examined to increase leveraging of projects. Participants include the Gas Research Institute (GRI), the Electric Power Research Institute (EPRI) and the seven vision industries. (\$2,000)
	\$ 0	\$ 0	\$ 2,000
Industries of the Future (Crosscutting) Total	\$ 38,378	\$ 49,120	\$ 49,400

INDUSTRIAL TECHNOLOGIES
INDUSTRY SECTOR
(dollars in thousands)

TECHNOLOGY ACCESS

I. Mission Supporting Goals and Objectives:

A. Statement of Mission: The Technology Access Program plays an important role in launching new industrial technologies from the research and development stage to the manufacturing plant where the technology can be used to boost the productivity and competitiveness of U.S. industry. The goal of the program is to facilitate and promote the introduction to industry of near-term and emerging energy efficiency, renewable energy and pollution prevention technologies.

The strategy of the Technology Access Program is to work closely and develop partnerships with key industrial firms, Federal, State and local governments, industry and trade associations, inventors, universities, and others with a stake in U.S. industrial competitiveness -- to jointly develop and implement innovative and effective ways to demonstrate, communicate and promote the benefits of energy savings, pollution prevention and cost savings possible through the adoption of energy-efficient industrial technologies. As a result of continuing dialogue with these partners, and based on feedback from industrial clients, an improved system for delivery of existing technical assistance services has been implemented. Under this new integrated delivery approach, near-term technical assistance services formerly available only through separate contacts with each of the individual programs, are now available on a single point-of-contact basis. By contacting staff from any of the technical assistance programs, industrial clients can get information and access to any of the services which might best fit their needs. Technical assistance can then be provided through the most effective combination of the individual Technology Access Programs.

As part of the Industries of the Future Program strategy, the Technology Access Program provides near-term technology implementation assistance to Vision Partners. Working closely with Vision Partners to bring successful R&D projects into the industrial marketplace allows the program to offer concrete evidence of the economic and productivity gains that are possible now through advanced, clean, and efficient technology. Successful partnerships developed with industry to speed the implementation of such technologies can significantly strengthen industry's commitment and resolve to work with the Office of Industrial Technologies on longer-term energy efficiency and pollution prevention solutions possible through the Industries of the Future Program.

I. Mission Supporting Goals and Objectives: TECHNOLOGY ACCESS (Cont'd)

The Technology Access Program is comprised of the following programs:

1) The Industrial Assessment Center (IAC)/Technology Transfer Program. The Industrial Assessment Center Program provides energy, waste, and productivity assessments to small- and medium-sized manufacturers in order to pinpoint and analyze opportunities for cost-effective energy, waste and productivity savings; and at the same time to provide hands-on training to engineering students in energy, waste and productivity management practices. It is also the only program which provides engineering students with both theoretical and practical plant experience in energy and waste management and productivity improvements. This university-based program serves parts of 43 states through 30 university engineering departments. IACs assist the Industries of the Future Partners and other manufacturers by providing assessments to vital industries, and by providing actual case study data on industry technologies with the greatest potential impact. The approximately \$45 million dollars provided to participating universities (since the Program's inception 21 years ago) to conduct assessments has generated an estimated \$375,000,000 in cost savings to manufacturers. This represents a ratio of \$8.00 for every Federal dollar spent.

The Technology Transfer Program is designed to provide an integrated approach to promoting the introduction of advanced, energy efficiency, renewable energy and pollution prevention technologies to industry. Through the development and dissemination of cohesive and effective information illustrating the benefits of technology partnership activities, the Technology Transfer Program provides a critical link between technology development and market penetration. The program reaches and influences industrial firms through the use of printed materials, online technical information, conferences and workshops.

2) The main goal of the Motor Challenge Program is to work in partnership with industry to increase the market penetration of energy efficient motor-driven systems. A key element in the Motor Challenge strategy is to encourage a "systems approach" to how motors, drives and motor-driven equipment are engineered, specified, purchased, and maintained by industry. This represents a whole new way of looking at motor efficiency and the potential for energy and cost savings. The program works closely with industry to: develop and disseminate unbiased technical information, provide technical tools and training; publicize successful technology deployment case studies and corporate activities; and create awareness amongst end-users of motor system efficiency opportunities. A targeted approach is being used to provide special focus on Vision industries.

3) The National Industrial Competitiveness through Energy, Environment, and Economics (NICE3) Program seeks to advance the competitiveness of U.S. industry by demonstrating the advantages of energy efficient, cleaner production in industry. The Program provides funding to State and industry partnerships (on a competitive basis) for projects that demonstrate advances in near-term, energy efficient, clean production technologies that are emerging or ready for commercialization. To date NICE3 has cost-shared 77 projects in 29 States. The program supports Industries of the Futures by using a solicitation to State agencies and industry that is designed to encourage energy and waste intensive industry participation.

4) The Inventions and Innovation Program offers opportunities for inventors, innovators, and entrepreneurs to make their energy-related ideas a commercial reality. The goal of the program is to stimulate U.S. economic growth by supporting the

I. Mission Supporting Goals and Objectives: TECHNOLOGY ACCESS (Cont'd)

development, market penetration, and commercial success of energy-related inventions and innovations from independent inventors, very small companies and universities. The Program supports Industries of the Future by targeting Innovative Concept grants to Vision industries.

B. Program Benefits: The program benefits for the Office of Technology Access listed below reflect the total impact projected in the years 2000, 2010, and 2020 from all prior funding still having an effect in those years.

	2000	2010	2020

Total Primary Energy Displaced (quads)	.24	.46	.63
Energy Cost Savings (\$billions)	.96	1.83	2.44
Carbon Reductions (million metric tons)	4.92	9.56	13.40

The dollar value of waste savings and productivity improvements have been estimated to be at least twice the energy cost savings.

C. Performance Goals: 1) Industrial Assessment Center (IAC)/Technology Transfer Program. IAC goals for the year 2000 include maintaining 30 primary partner level schools, with increased interaction with trade associations, State & local governments, and industry through the industry Vision process; establishing joint programs and inter-agency training with the National Institute of Standards and Technology's Manufacturing Extension Centers (as part of the Climate Change Technology Initiative); conducting 750 industrial assessments year; complete a cumulative 9,900 assessments; and train a cumulative total of 2,945 engineering professionals in energy and waste management. Goals for the Technology Transfer Program for the year 2000 include increased participation in outreach and communications events that impact adoption of energy efficiency and pollution prevention technologies, improving and increasing tools that effectively communicate the benefits of industrial efficiency and pollution prevention, and supporting the Industries of the Future and partnership programs by providing effective communications tools.

2) Motor Challenge goals: By the year 2000, have over 1,200 plants participating in the program, the combined energy consumption of these plants representing 6.5% of total current annual industrial electric motor energy consumption.

3) NICE3 goals: By the year 2000, at least 35 states will have participated in the program, building a stronger relationship between state energy offices and state departments of environmental protection. Also by 2000, NICE3 will have supported over 100 demonstrations of near-term innovative technologies that are ready for commercialization.

4) The Inventions and Innovations Program goal for the year 2000 is to have supported new inventions and innovations that result in over \$1.2 billion in cumulative sales, with an increased emphasis on technologies for energy intensive industries.

I. Mission Supporting Goals and Objectives: TECHNOLOGY ACCESS (Cont'd)

The Climate Wise program was zeroed-out by Congress in FY98, giving direction that the Environmental Protection Agency should be the sole funding source.

II. A. Funding Table: TECHNOLOGY ACCESS

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	\$ Change	% Change
IACs/Technology Transfer	\$ 8,125	\$ 9,109	\$ 8,700	\$ -409	-4%
Motor Challenge	5,138	6,230	11,000	4,770	77%
NICE-3	5,800	6,000	7,500	1,500	25%
Climate Wise	1,000	0	0	0	0%
Inventions & Innovation	4,764	4,960	4,800	-160	-3%
Total, Technology Access	<u>\$ 24,827</u>	<u>\$ 26,299</u>	<u>\$ 32,000</u>	<u>\$ 5,701</u>	<u>22%</u>

II. B. Laboratory and Facility Funding Table: TECHNOLOGY ACCESS

	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	\$ Change	% Change
Idaho National Engineering Lab	\$ 0	\$ 50	\$ 50	\$ 0	0%
Lawrence Berkeley Lab	500	700	900	200	29%
National Renewable Energy Lab	800	1,340	1,040	-300	-22%
Oak Ridge National Lab	1,335	1,230	1,630	400	33%
Pacific Northwest Lab	400	440	350	-90	-20%
All Other	21,792	22,539	28,030	5,491	24%
Total, Technology Access	<u>\$ 24,827</u>	<u>\$ 26,299</u>	<u>\$ 32,000</u>	<u>\$ 5,701</u>	<u>22%</u>

III. Performance Summary: TECHNOLOGY ACCESS

Activity	FY 1997	FY 1998	FY 1999
IACs/Technology Transfer	<p>The Industrial Assessment Center (IAC)/Technology Transfer Program is comprised of two separate activities: The Industrial Assessment Center Program and the Office of Industrial Technologies Technology Transfer Program.</p> <p>Industrial Assessment Centers (IACs)</p> <p>The Industrial Assessment Center Program in its twenty-first year serves the dual purposes of: 1) providing energy, waste and productivity assessments to small-and medium-sized manufacturing facilities that typically do not have the staff or finances to evaluate their own operations; and 2) providing hands-on training to engineering professionals. These centers, located at 30 participating universities, conduct the assessments and provide manufacturers with recommendations on cost effective energy, waste and productivity savings.</p> <p>In FY 1997 the IACs conducted 750 combined energy and waste</p>	<p>Industrial Assessment Centers (IACs)</p> <p>Support for Industrial Assessment Centers operating at 30 participating universities continues. Approximately 750 combined energy, waste and productivity assessments are conducted.</p> <p>An annual IAC Director's meeting for the exchange of information and experience is held. The Program continues to make available to manufacturers and the public (through Rutgers University) a database of assessment results based on approximately 8,400 IAC audits and assessments.</p> <p>Top performing schools are given incentives to look at and evaluate innovative program approaches,</p>	<p>Industrial Assessment Centers (IACs)</p> <p>Support for Industrial Assessment Centers continues. Approximately 750 combined energy, waste and productivity assessments are conducted.</p> <p>An annual IAC Director's meeting for the exchange of information and experience is held. The Program continues to make available to manufacturers and the public (through Rutgers University) a database of assessment results based on approximately 9,150 IAC audits and assessments.</p> <p>Top performing schools are given incentives to look at and evaluate innovative program approaches.</p>

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
IACs/Technology Transfer (Cont'd)	<p>assessments and trained 225 engineering students.</p> <p>The program conducted an annual IAC Director's meeting to exchange information and experience; and continued to maintain (at Rutgers University) a database which provides public access to technical information on the results of approximately 7,650 audits and assessments. This data is available by SIC code.</p> <p>The IAC Program also makes available a best practices manual for manufacturers that don't meet program criteria for an assessment. The Program saves energy and money, helps reduce industrial pollution, and has the added benefit that students trained by the IACs are able to take practical energy and waste management skills to their employers after graduation. (\$7,125)</p> <p>Technology Transfer Program</p> <p>The Technology Transfer Program answers a need common to all industry for credible technical information on potential applications and performance of</p>	<p>such as pilot two-day assessments and assisting manufacturers in identifying and obtaining the financing and technical assistance necessary to implement assessment recommendations.</p> <p>Collaborative work with State agencies continues. Work that strengthens university and local industry cooperation continues. (\$8,309)</p> <p>Technology Transfer Program</p>	<p>Collaborative work with State agencies continues. Work that strengthens university and local industry cooperation continues. (\$8,300)</p> <p>Technology Transfer Program</p>

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
IACs/Technology Transfer (Cont'd)	<p>energy efficiency and pollution prevention technologies. The strategy of the Program is to partner with industry to develop and use technology demonstrations, publications, online technical information, clearinghouse services, conferences and workshops that get information into the hands of potential users. It searches for innovative and efficient methods of disseminating the message that energy efficiency and pollution prevention measures are good for business, good for the environment, and good for the U.S. economy.</p> <p>The Technology Transfer Program continues to work closely with industry to develop outreach products to convey the benefits of advanced energy efficient, pollution prevention technology. The Program continues to look for and promote new applications for OIT developed technologies and continues to develop and improve tools that effectively communicate the benefits of industrial energy efficiency and pollution prevention, while supporting the</p>	<p>The Technology Transfer Program continues to work closely with industry to develop outreach products to convey the benefits of advanced energy efficient, pollution prevention technology. The Program continues to look for and promote new applications for OIT developed technologies and continues to develop and improve tools that effectively communicate the benefits of industrial energy efficiency and pollution prevention, while supporting the</p>	<p>The Technology Transfer Program continues to work closely with industry to develop outreach products to convey the benefits of advanced energy efficient, pollution prevention technology. The Program continues to look for and promote new applications for OIT developed technologies and continues to develop and improve tools that effectively communicate the benefits of industrial energy efficiency and pollution prevention, while supporting the</p>

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
IACs/Technology Transfer (Cont'd)	Industries of the Future and the Technology Partnership Programs. Continue technology commercialization tracking and analysis for lessons learned. (\$1,000)	Industries of the Future and the Technology Partnership Programs. Continue technology commercialization tracking and analysis for lessons learned. (\$800)	Industries of the Future and the Technology Partnership Programs. Continue technology commercialization tracking and analysis for lessons learned. (\$400)
	\$ 8,125	\$ 9,109	\$ 8,700
Motor Challenge	More than 49 million electric motors convert electricity into useful work in U.S. manufacturing operations. The cost to industry is over \$30 billion annually. In addition, motor-driven system energy usage is 70% of the total industrial electricity market. Consequently, increases in the energy efficiency of existing motor systems can lead to dramatic nationwide energy savings. Industry has traditionally looked at its equipment with a component focus, e.g., one motor, one pump, one drive system, etc., at a time. Accordingly, significant systems-oriented efficiency gains are often overlooked. The strategy of DOE's Motor Challenge Program is to create industry/government partnerships designed to assist and encourage	All Vision industries will be targeted and supported by Motor Challenge. These industries comprised over half of the U.S. manufacturing sectors motor system electricity consumption. Motor Challenge products will be tailored to each industries application-specific needs and delivered to plant sites in partnership with the industry end-user trade associations and Motor Challenge end-user Partner corporate offices. The FY 1997 Allied Partners and Excellence Partners will continue to be supported in FY 1998. Implementation of motor systems management plans at all plant sites will be intensified, as well as the documentation of energy savings results. Motor Challenge will	

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Motor Challenge (Cont'd)	<p>industrial end-users to adopt the systems approach in managing, specifying, purchasing, and maintaining their electric motors, drives, and motor-driven equipment (e.g., pumps, fans, and compressors).</p> <p>Efforts in FY 1997 focused on expanding partnerships with both end-user and non-end-user companies (suppliers, distributors, motor repair shops, utilities), and trade associations. The partnership activities emphasize the development and dissemination of products and services designed to assist industrial clients in managing their motor-driven systems more effectively.</p> <p>Industry partnerships will be expanded in coordination with the Industries of the Future efforts. Motor Challenge collaboration with the Forest Products industry (as part of Agenda 2020), in assisting pulp and paper mill personnel to implement more effective motor systems management strategies, will be used as a model to develop similar partnership activities with the Chemical and Steel industries.</p>	<p>offer tailored technical assistance to Excellence Partners, and will facilitate the support by Allied Partners to aid in the implementation of motor system technology at each Excellence Partner plant site.</p>	

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Motor Challenge (Cont'd)	<p>Motor Challenge activity with the Allied Partners and Excellence Partners will be accelerated in FY 1997, and will focus on the implementation of action plans. One hundred Allied Partners will be signed on by the end of FY 1997, and will be using Motor Challenge products (tools, training curriculum, software) in various ways to promote motor-driven system energy efficiency to end-users. Twenty-five Excellence Partner companies and DOE will be working together to capture energy savings opportunities.</p> <p>Other program activities are as follows:</p> <p>The FY 1995 and FY 1996 Showcase Demonstration projects will be continued. A total of 15 projects will be completed by the end of FY 1997, leaving an additional 15 projects to be ongoing (30 total projects). Showcase case studies will be used to encourage other facilities with similar applications to replicated results.</p> <p>The Information Clearinghouse will disseminate information to</p>	<p>Other program activities are as follows:</p> <p>The FY 1995 and FY 1996 Showcase Demonstration projects will be completed (30 projects total). An additional 10 projects will be initiated in FY 1998 representing different potential applications and case studies to be shared nationally.</p>	<p>Activities will continue to catalyze the efforts of suppliers, distributors, utilities, states and trade associations to develop and deliver the tools and technical assistance manufacturers need to make informed decisions about motors and motor-driven systems.</p> <p>Efforts to target Motor Challenge technical support for Industries of the Future will be accelerated. Building on experience gained in FY 1997 and 1998 all Industries</p>

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Motor Challenge (Cont'd)	<p>over 5,000 people directly, and 10,000 more through an internet WEB site.</p> <p>Industry partnerships with supplier trade associations will be expanded to bring more reliable and independently validated information to end-users so they can make more informed motor system design, specification, and purchase decisions. Examples of products from the industry partnerships, include: new specification guidelines for specific equipment (e.g., air compressors), new training products and curriculum, equipment design and performance databases from multiple manufacturers, and generic application-oriented videotapes. (\$5,138)</p> <p>No Activities. (\$0)</p>	<p>The Information Clearinghouse will disseminate information to over 10,000 people directly, and 25,000 more through an internet WEB site. Activities will continue to catalyze the efforts of suppliers, distributors, utilities, states, and trade associations to develop and deliver the tools and technical assistance manufacturers need to make informed decisions about motors and motor systems. (\$6,230)</p> <p>No Activities. (\$0)</p>	<p>of the Future will be targeted and supported by Motor Challenge. Motor Challenge products will be tailored to each industry's specific needs and delivered in partnership with the appropriate industry associations and cooperating Motor Challenge Partners in each sector. (\$8,000)</p> <p>To address a need identified by Motor Challenge Partners, and in conjunction with efforts to streamline OIT's technical assistance delivery system, expanded technical assistance on enhanced, energy efficient steam and compressed air system technologies will be offered to</p>

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Motor Challenge (Cont'd)			industrial clients. Industrial steam systems currently account for 6 quads of energy per year, over one-fifth of all energy consumed by the manufacturing sector. Compressed air systems represent \$1.5 billion per year in costs and are referred to as the fourth plant utility. These activities will be modeled after the Motor Challenge strategy of developing industry/government partnerships to produce and deliver credible tools, information, and assistance. (\$3,000)
	\$ 5,138	\$ 6,230	\$ 11,000
NICE-3	The National Industrial Competitiveness Through Energy, Environment and Economics (NICE3) Program is in its seventh year in FY 1997. The Program, which is designed to improve competitiveness, foster energy efficiency, and reduce waste, provides funding to State and industry partnerships (on a competitive basis). NICE3 supports projects which demonstrate energy efficient, clean production technologies that	In FY 1998 several activities are planned to improve the delivery of the Program and enhance its value to the States and industry. NICE3 will fund 10-15 proposals through its competitive solicitation process. The Program will continue to offer a non-regulatory, competitive approach to improved energy efficiency, reduced emissions and pollution prevention. The Windows-based proposal preparation software first	NICE3 will fund 18-20 proposals through its competitive solicitation process. The Program will continue to offer a non-regulatory, competitive approach to improved energy efficiency, reduced emissions and pollution prevention. The Windows-based proposal preparation software will continue to be made widely available for the preparation of applications. The use of this software will reduce the cost and time required

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
NICE-3 (Cont'd)	<p>are emerging or ready for commercialization.</p> <p>States identify appropriate needs and targets, and work with industry to develop proposals that define the specific technologies, processes and procedures that meet their needs and will accomplish their objectives. The Program provides incentives to stimulate investments in innovative, near term technology that supports economic growth, creates new jobs and protects the environment. NICE3 requires joint funding of at least 55% of total project costs.</p> <p>In FY 1997 NICE3 funded 13 new State/industry proposals through its competitive solicitation process. The Windows-based proposal preparation software that was developed in FY96 will be available to proposers for the first time. This software will greatly streamline the application process and reduce the cost and time of applications, processing and evaluation.</p>	<p>distributed in FY 1997 will now be widely available for the preparation of applications.</p> <p>Increased emphasis will be placed in the solicitation on the commercialization and deployment of projects to promote additional replications of the technology. Activities will be added to assist grant recipients in deploying successful technologies and encouraging replication for wide industrial application.</p> <p>Regional proposal funding workshops will be offered to projects/State agencies applying for funding, but not receiving grants. Additionally, workshops will be offered by those States with the highest proposal success rates to help promote greater penetration by less successful States. Additional partners for funding "green" projects will be sought. These activities will increase the cost leveraging of the NICE3 program. (\$6,000)</p>	<p>to prepare proposals, evaluate them and make grant awards.</p> <p>Increased emphasis will continue to be placed in the solicitation on commercialization and deployment of projects to promote additional replications of the successful technologies. Activities to assist grant recipients in encouraging wide replication will be continued.</p> <p>Efforts will continue to provide workshops and training to assist States who have not previously been successful in receiving grants. Workshops led by States with high proposal success rates will continue to be supported in an effort to broaden the reach of the Program. (\$7,500)</p>

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
NICE-3 (Cont'd)	<p>NICE3 will continue to encourage participants to leverage federal funds, requiring a 55% cost-share level in FY 1997.</p> <p>Project summary sheets and the solicitation continue to be made available on the Internet. Emphasis continued on developing case studies and focusing on ways to replicate program successes. (\$5,800)</p>		
	\$ 5,800	\$ 6,000	\$ 7,500
Climate Wise	<p>PARTNERSHIPS FOR TECHNOLOGY INTRODUCTION: The Climate Wise Program operates as a partnership between U.S. industry and the Federal Government and focuses on the highest energy-consuming processes and technologies currently used by the seven Industries of the Future. The Program encourages these industries to take advantage of the economic and environmental benefits associated with the adoption of advanced, energy-efficient technologies that prevent pollution and reduce overall greenhouse gas emissions.</p>	<p>PARTNERSHIPS FOR TECHNOLOGY INTRODUCTION: In 1998, Climate Wise plans to provide technical assistance and information on energy efficiency technologies to the Climate Wise industrial partners using prior year funds, at a greatly reduced level of effort. (\$0)</p>	<p>Activities on Climate Wise will be brought to an orderly close and the program will be terminated. (\$0)</p>

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Climate Wise (Cont'd)	<p>In cooperation with Climate Wise at the Environmental Protection Agency (EPA), industrial partners are expected to set and achieve meaningful emission reduction goals; undertake specific action to addresses energy, source, process, materials and behavioral problems; and report the reductions through the Voluntary Greenhouse Gas Reduction Reporting System established under section 1605b of EPAAct.</p> <p>Climate Wise will begin working on the 16 industry-state government partnerships established in 1996. The Program expects to begin several showcase activities in Vision Industry companies that also include technologies supported by other Technology Access Programs. These activities will demonstrate the economic and environmental benefits associated with the adoption of advanced energy-efficient technologies and promote the concept of a strategic corporate-wide approach.</p> <p>In addition, the Program will conduct a workshop on innovative approaches to financing energy-efficient technologies for</p>		

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Climate Wise (Cont'd)	<p>small business and offer technical assistance to partner-companies as they progress in completing their action plans. The technical assistance will be provided through the IAC Program, new informational material and software packages, DOE labs, universities and others, to qualifying company partners.</p> <p>Projected results for the program in 1997 include adding about 80 company partners (increasing program participation to 3.4% of U.S. industrial energy use). (\$1,000)</p> <p>\$ 1,000</p>	\$ 0	\$ 0
Inventions and Innovation	<p>The Inventions and Innovation Program comprises two major programs: The Energy-Related Inventions Program (ERIP) and the Innovative Concepts Program (InnCon). ERIP fills the vacuum created by lack of private sector, early-stage venture capital for energy technologies by offering a technical evaluation, a market assessment, training in managing the commercialization process, and funding for worthy inventions.</p>		

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Inventions and Innovation (Cont'd)	<p>The National Institute of Standards and Technology (NIST), with DOE funding, conducts a technical evaluation (at no cost to the inventors). NIST evaluates approximately 1,000 submissions each year. Based on successful technical evaluations, NIST recommends about 35-40 cross-cutting inventions to DOE each year for consideration of financial support. DOE then examines whether there is a sufficient market for the invention, helps the inventor to understand the business and marketing components of a successful enterprise, and awards about 20 grants per year, valued at up to \$100,000 each.</p> <p>Energy-Related Inventions Program (ERIP) and Innovative Concepts Program (InnCon) continue to assist in the development of new technology by private sector individuals and start-up businesses. ERIP, through NIST, will evaluate over 1,000 submissions with 30-31 recommended for support.</p> <p>Continue National Innovation Workshops to increase the quality of submissions to the Program,</p>	<p>Continue ERIP grants and InnCon solicitation to support Industries of the Future.</p> <p>Continue National Innovation Workshops to bring new energy-saving inventions into the marketplace. (\$4960)</p>	<p>The Energy Related Inventions Program (ERIP) and the Innovative Concepts Program (InnCon) continue to assist in the development of new technology by private sector individuals and start-up businesses. The recommendations from the strategic program review conducted in FY 1997 will be fully implemented.</p> <p>ERIP will continue to provide evaluations and support of</p>

III. Performance Summary: TECHNOLOGY ACCESS (Cont'd)

<u>Activity</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Inventions and Innovation (Cont'd)	while providing the public with educational information on legitimate sources of commercialization assistance. (\$4,764)		energy-related inventions. (\$4,800)
	\$ 4,764	\$ 4,960	\$ 4,800
Technology Access Totals	\$ 24,827	\$ 26,299	\$ 32,000

INDUSTRIAL TECHNOLOGIES
INDUSTRY SECTOR
(dollars in thousands)

MANAGEMENT AND PLANNING

I. Mission Supporting Goals and Objectives:

The request supports 72 full-time equivalent (FTE) positions to maintain adequate program management and support for the Industrial Sector Program (Interior and Related Agencies). This program also includes Technical Evaluation, Analysis and Planning.

II. A. Funding Table: MANAGEMENT AND PLANNING

Program Activity	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Request	\$ Change	% Change
Evaluation and Planning	\$ 500	\$ 800	\$ 1,000	\$ 200	25%
Program Direction	6,387	6,900	8,159	1,259	18%
Total, Management and Planning	<u>\$ 6,887</u>	<u>\$ 7,700</u>	<u>\$ 9,159</u>	<u>\$ 1,459</u>	<u>19%</u>

II. B. Laboratory and Facility Funding Table: MANAGEMENT AND PLANNING

All Other	\$ 6,887	\$ 7,700	\$ 9,159	\$ 1,459	19%
Total, Management and Planning . .	<u>\$ 6,887</u>	<u>\$ 7,700</u>	<u>\$ 9,159</u>	<u>\$ 1,459</u>	<u>19%</u>

III. Performance Summary: MANAGEMENT AND PLANNING

Activity	FY 1997	FY 1998	FY 1999
Evaluation and Planning	<p>Provided technical evaluation, analysis, and planning for the program. (\$500)</p> <p>\$ 500</p>	<p>Provide increased technical evaluation, analysis, and planning with emphasis on development of quality metrics for the energy intensive industries. (\$800)</p> <p>\$ 800</p>	<p>Provide increased technical evaluation, analysis, and planning, including development of quality metrics for the energy intensive industries. (\$1,000)</p> <p>\$ 1,000</p>
Program Direction	<p>The following is a breakdown of the funding by Object Class:</p> <p>11.9 Personnel compensation \$ 4,901 12.1 Civilian personnel benefits \$ 1,092 1.0 Travel and transportation of persons \$ 663 25.2 Other services \$ 0</p> <p>Funds supported the salaries, benefits, and travel (including normal increases in both salaries and benefits) for 70 FTEs needed to conduct and monitor research, development of the various Industry technologies, at Headquarters and in the field and to support implementation of the Industry sector requirements of the Energy Policy Act of 1992. The actual funding obligations reflected in</p>	<p>The following is a breakdown of the funding by Object Class:</p> <p>11.9 Personnel compensation \$ 5,272 12.1 Civilian personnel benefits \$ 1,170 21.0 Travel and transportation of persons \$ 458 25.2 Other services \$ 0</p> <p>Funds support the salaries, benefits, and travel (including normal increases in both salaries and benefits) for 72 FTEs needed to conduct and monitor research, development of the various Industry technologies, at Headquarters and in the field and to support implementation of the Industry sector requirements of the Energy Policy Act of 1992. (\$6,900)</p>	<p>The following is a breakdown of the funding by Object Class:</p> <p>11.9 Personnel compensation \$ 5,451 12.1 Civilian personnel benefits \$ 1,280 21.0 Travel and transportation of persons \$ 560 25.2 Other services \$ 368</p> <p>Funds are requested to support the salaries, benefits, and travel (including normal increases in both salaries and benefits) for 72 FTEs needed to conduct and monitor research, development of the various Industry technologies, at Headquarters and in the field. The request for other services supports such activities as training, permanent change of station moves, and a small contingency.</p>

III. Performance Summary: MANAGEMENT AND PLANNING (Cont'd)

Activity	FY 1997	FY 1998	FY 1999
Program Direction (Cont'd)	the object class distributions includes \$269,000 of FY 1996 unobligated carryover funds. (\$6,387)		\$500,000 of the funding will be utilized with the policy office of DOE for work with the Environmental Protection Agency on developing mechanisms and policy for industry to pledge to reduce carbon emissions and to bank carbon credits. (\$8,159)
	\$ 6,387	\$ 6,900	\$ 8,159
Management and Planning Total	\$ 6,887	\$ 7,700	\$ 9,159